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## Original Correspondence.

### IRONWORKS AND COLLIERIES IN DERBYSHIRE.

#### THE STAVELEY COMPANY.

Of the works in Derbyshire finding profitable employment for thousands of hands those belonging to the Staveley Company are entitled to the premier position, having for a long series of years enjoyed a high reputation not only for their productions, but for the means adopted at them for improving the position of their workmen (numbering between 4000 and 5000) and their families by stimulating education, provident habits, and self-respect, and by holding out inducements to those who showed a desire to raise themselves in the social scale. Ability, combined with steadiness, has always led to merited promotion, and few places can boast of having so many men who beginning at the lower round of the ladder have advanced towards the top so quickly.

The works are situate about four miles from Chesterfield, by the side of the Midland Railway, and cover an area of more than 20 acres, whilst the several collieries are more or less distant, one, however, being near to the furnaces. For very many years the works were carried on by members of the Barrow family, but about six years ago they were taken to by the present company, of which Mr. J. Barrow is now the Chairman, and Mr. C. Markham the managing director—a gentleman alike esteemed for his business habits, courtesy, and the deep interest he takes in all that relates to the welfare of the numerous workmen connected with them. The foundry is one of the largest in the kingdom, and has long been famed for its gas and water pipes, as well as other castings, and so successful have been the operations under the present management that the 100*l.* shares, on which 60*l.* are paid, are quoted at from 40*l.* to 41*l.* premium.

Going from Derby by way of Masborough to the North by the Midland Railway the attention of travellers cannot fail being drawn to the large works on the right, and the substantial stone buildings on the left. On passing onwards will be noticed hundreds of pipes in all directions, some of them 56 in. in diameter, two or three lines of rails blocked up with full and empty coal wagons (some of which may be seen a day or two afterwards at Cheltenham, Gloucester, or London), and the flickering blaze from four large furnaces.

At present there are four iron-cased furnaces in blast, three of them being 50 ft. high, and the other 65 ft. in height. They are 20 ft. in diameter, 8 ft. in the bosh, and are worked with five tuyeres, the gas being taken from the top for the heating of the boilers and stoves. A hydraulic lift supplies three of them with the ore and other material required in smelting, whilst the fourth has an incline for the same purpose. There are several engines of various power, they include a double blowing steam-engine, one with a 36-in. and 72-in., and another steam-cylinder 42-in., and a blowing-engine 80-in. diameter. There is also an air-engine with 100-in. cylinder, and a blast-engine with a 50-in. cylinder. Those engines, as well as others, together with a number of boilers, were made by the company Several of the boilers are double-flued ones, but the greater part of them are single. Two new furnaces of about the same height as those in blast are all but completed, and will shortly be blown in. In connection with them a fine chimney stack, 186 ft. high and 12 ft. wide, has just been finished. They will be fed by an hydraulic lift, and the necessary blast will be supplied from the engines now working the other furnaces in operation. The company raise a good deal of ironstone from their own pits, but it is largely supplemented by importations from Wellingborough and the neighbourhood, and also from North Lincolnshire—the former containing a good deal of silica, and, consequently, well adapted for mixing with the Derbyshire ore, and so producing a very good quality of "pig." The present output of iron from the furnaces will be at the rate of upwards of 40,000 tons per annum, but with the aid of the new furnaces the quantity will, probably, considerably exceed 60,000 tons a year.

There are several large casting shops, where every description of work is produced from the smallest articles to pipes of all sizes, up to 56 in. diameter, great pillars and girders weighing upwards of 10 tons, large columns and cylinder bottoms, with wheels of all dimensions. There are four pipe shops, in one of which about a dozen of the largest that are made can be turned out in a day. Pipes, indeed, are one of the specialities of the Staveley Company, and such is the demand for them that the vast establishment is taxed to the utmost to keep pace with the requirements of consumers. The output of finished work in the shape of castings it will be seen is very large, and we believe that upwards of 100 tons are sent away daily.

There is a large boiler yard fitted with all the requisites for that important branch of business, and a smith's shop, with steam-hammer and other necessary appliances. The fitting shops are replete with pipe boring and other lathes, a radial drilling machine, planing machines, and machines of every description for turning, drilling, and other purposes. The pattern shops are large, and some of the models were of a very large description, including some double girders for the East London Waterworks, the casting of one of which would weigh upwards of 10 tons. There are, of course, circular and other saws, and all the usual appliances for economising labour.

Several large collieries are worked by the Staveley Company, the production being something like 800,000 tons a year; the area of the field is between 3000 and 4000 acres, one of the principal lessors being the Duke of Devonshire. The seams worked are the Black Shale, or Silkstone, and the well-known Barnsley, or Upper Hard. The Hard coal in the district around Staveley, according to the opinion of Mr. Woodhouse, the eminent mining engineer, is the finest in any part of the coal field. It is about 6 feet in thickness, and there is no separation between the Upper Hard and the Main seam, the section being—Top or Upper, Soft, One Foot, Hard, Three Feet, Lower Soft (in which there is an inferior Cannel, called Branch coal), Two Feet. Besides the large consumption at the works, there are some thousands of tons sent weekly to London, Birmingham, and the West of England, as well as to Grimsby, the company having a vast number of wagons engaged in the trade.

One of the principal collieries is the Springwell, from which about 1000 tons of coal are drawn daily, the seam being the Black Shale, of fine quality, and about 4 feet 6 inches thick. The shaft, which is 12 ft. in diameter, is 89 yards deep. The pit is also entered by an incline plane, so that there are two outlets for drawing. There is a 16-in. cylinder engine for drawing, with ordinary boilers. There is also a 52-in pumping-engine, 7 ft. 6 in. stroke, with three 12-in. pump lifts. At this colliery is the largest fan at present at work in England in any of our coal mines. It is on Guibal's principle, is 40 ft. 6 in. in diameter, 11 ft. wide, giving 47 revolutions per minute. The water-gauge is 3·2, and the fan produces 145,000 cubic feet of air per minute. By it not only the Springwell, but also the Campbell pit, and an ironstone mine, the produce of which is drawn up a drift, are ventilated. The upcast shaft is used for the purposes of the fan alone, and is 14 ft. in diameter. The engine which works the fan is a 33-in. cylinder, 2 ft. 6 in. stroke, the steam being cut off at about 12 per cent. by a separate expansion valve.

The Campbell Colliery to the Silkstone seam is about 240 yards deep, the shaft being 14 ft. diameter. The thickness of the seam varies very much, in some places being 5 ft., and in others as much as 7 ft. 6 in. There are a pair of winding-engines, 30-in. cylinders, with 5-ft. stroke. An underground engine is being fixed, for the purpose of forcing the water from the bottom to the top in one column.

In the Old Hollingwood pit the Deep Soft coal, or Hollingwood seam, 4 ft. 6 in. thick, is being worked. The shaft is 80 yards deep, the ventilation being procured by means of one of Guibal's fans, 30 ft. in diameter, working 60 revolutions a minute, giving 110,000 cubic feet of air in the same time, the water-gauge being 2·8. There is also a 52-in. cylinder pumping-engine, 7-ft. stroke, and 14-in. lift, with an underground hauling-engine for a double road, 10 corves being drawn on each by a wire-rope.

In connection with the former is the New Hollingwood pit, 220 yards deep, having a 30-in. vertical winding-engine, and a direct-acting engine forcing the water to the top from the bottom.

At the Speedwell pit the finest seam of coal in the district is being got—that known as the Top Hard, or Barnsley bed. There are two shafts, each 8 ft. in diameter, and 157 yards deep. There is a 28-in. cylinder engine, with 4-ft. stroke. Connected with the pit is that known as the Seymour pit, there being a good road from one to the other, and both, of course, working the same seam.

The Seymour Colliery is 170 yards deep, with a 15-ft. shaft, the Hard coal being about 6 ft. in thickness, and of excellent quality. There are a pair of 22-in. winding-engines, 4-ft. stroke, with a pumping-engine 55-in. cylinder, 9 ft. stroke, and a 19-in. pump. There are also six boilers, 50 ft. long and 5 ft. in diameter.

The company have also a colliery called the North Staveley, near to Rotherham, and sunk to the Barnsley seam, which is about 4 ft. 6 in. in thickness. The shaft is 212 yards deep, and 12 ft. in diameter. There are a pair of 22-in. cylinder engines, and the ventilation is of the ordinary furnace character. The Black Shale ironstone, raised and used at Staveley, varies in depth from 18 to 23 ft.

With regard to the collieries in Derbyshire, it may be said that there are no Unions connected with them, a fact owing to the great strike which took place at Staveley in 1866, and is now spoken of as the greatest contest between labour and capital in connection with mining operations that ever took place in the Midland coal field. The South Yorkshire Miners' Association, emboldened by the success which had attended their efforts in their own immediate district, attempted to extend their principles into Derbyshire, and for that purpose they tried one of the strongest companies in the county—the Staveley. Some hundreds of the men joined the ranks of the Unionists, and for a time lived on a few shillings a week, being assured that the manager would be obliged to give way. Mr. Markham, however, made known that on no consideration would Unionists be employed at the collieries, and showed that he was determined to keep his word. His firm and determined attitude soon caused a reaction, and a movement having been made by some of the men who had kept aloof from the agitators and Unionists to assert the independence of labour, they were soon joined by the waverers, and many of those who wished to become members of the Miners' Association. Three months after the attempt to make Staveley the hotbed of Unionism, more than 1000 men joined the body in favour of individual independence, and shortly afterwards the South Yorkshire executive of the Association admitted they were defeated. To Mr. Markham belongs the credit of having kept the county of Derby free from Unionism and strikes, so far as the mining body is concerned, and the latter are not slow to admit that they have been benefited by the course then pursued, although at the time it was opposed to the views they held after hearing the speeches of those who desired to allure them from the allegiance due to the company who had so long employed and paid them. All that is now past, and in no part of the kingdom, perhaps, is there a better cared for, better paid, or more contented body than the Staveley miners.

That the Staveley Company have done more to promote the welfare of all persons connected with their works than is probably the case with regard to any similar establishment in the kingdom may be inferred when we state that, on taking to the concern from Mr. Barrow, nearly 6000*l.* were paid for the schools where children of all ages were now educated, whilst more recently technical classes for adults were formed. For the workman's hall, where there is a reading-room, and where the men can have their meals at a very low rate, 4000*l.* were paid, and where a good breakfast is supplied for 3d., and dinner, including soup, meat, vegetables, and bread, for 5d. Of course, the cost of finding so cheap a meal does not pay the providers, but the company make up all deficiences. During the six years or so since the works were transferred the company have spent upwards of 20,000*l.* in providing for the educational and other wants of those they employ and their families. There is a sick fund, the receipts of which last year amounted to 2487*l.*, and the expenditure to about the same amount.

The necessity for miners and other persons engaged in dangerous employment insuring against death or accidents has been fully carried out at the Staveley Works. It was commenced on its present basis in 1867, the company having promised 2000*l.* towards the funds, in four annual sums of 500*l.* At the close of the last financial year there was in balance in hand of nearly 2000*l.* Awards varying in amount are made to members, and we find that the representative of one man who was killed by machinery received 100*l.*; another 52*l.*; whilst a man who had four fingers amputated was paid 38*l.* In another instance, a man was killed by getting out of the workmen's train, and although such accidents did not bring the unfortunate fellow within the rules of the society, yet 68*l.* were given to his representative. Well may it be asked, in what Unionist district in the kingdom do the workmen enjoy such benefits?

There are between 500 and 600 workmen's houses belonging to the company, with handsome residences for the officials. There is also a workmen's train to and from Chesterfield—a distance of four miles—the charge being 1d. for the journey, or 1s. a week to and fro.

Mr. Markham, who is one of the county magistrates, a position for which his long connection with the working classes pre-eminently qualifies him, enjoys in a very high degree the confidence of the vast body employed by the Staveley Company.

Truck is unknown at Staveley—yet the men are attentive to their work, their families are respectably dressed, whilst a spirit of independence is maintained by all.

### COLLIERIES IN NORTH DURHAM, THEIR WORKINGS AND MACHINERY—No. XVI.

The Sherburn Collieries, with those at Cocken, Brasside, and Frankland, constitute the third section in our description of the Earl of Durham's Lambton Collieries; this section is under the management of Mr. T. Crawford, assisted by Mr. Logan, as resident viewer.

The Sherburn Collieries comprise Littletown, Sherburn Hill, Sherburn House, and Lady Durham Pits, with an area of 4000 acres of mineral property. The pits are all situated on the outside of and the three first near the limits of the magnesian limestone and new red sandstone formations, so that the strata sunk through in them were entirely confined to alluvial deposit and the coal measures; the former has been found in two cases of considerable thickness, but no extraordinary difficulty with water or sand was encountered in this deposit. Large water feeders were met with in the coal measures, a little above the Five-quarter seam, amounting to 1000 gallons per minute, both at Littletown and Sherburn Hill pits. Feeders smaller in quantity were met with at Sherburn House and Lady Durham pits in a similar position. In the whole of the pits the water was dammed back by cast-iron tubbing as they were sunk. These feeders are found to have abated considerably since the mines have been worked. The coal measures on the western side of the properties have been denuded to a great extent, only two seams of coal are found there, and the existence of the lower seams down to the Brockwell has not been proved by boring or sinking in any part of them. The following sections of the seams of coal found at each colliery will show the effect of denudation:—

| | | Thickness. | | | Depth. |
|---|---|---|---|---|---|
| **LITTLETOWN COLLIERY:—** | | | | | |
| 1—Five-quarter seam .. | House coal..... | 3 ft. | 4 in. | ..... | 41 fms |
| 2—Main coal seam .... | Coarse coal ..... | 4 | 0 | ..... | 54 ,, |
| 3—Maudlin seam ..... | Black stone ..... | 3 | 6 | ..... | 63 ,, |
| 4—Low Main seam .... | Coal ..... | 1 | 4 | ..... | 81 ,, |
| 5—Hutton seam ..... | Good coal .... 4 ft. 6 in. | | | | |
| | Coarse ditto ... 1 2 =5 | 8 | | ..... | 95 ,, |
| **SHERBURN HILL COLLIERY:—** | | | | | |
| Five-quarter seam .... | Good coal, not yet worked | 3 | 6 | ..... | 37 ,, |
| Hutton seam ..... | Good coal .... 4 ft. 2 in. | | | | |
| | Coarse ditto ... 1 2 =5 | 4 | | ..... | 90 ,, |
| **SHERBURN HOUSE COLLIERY:—** | | | | | |
| Low Main seam..... | Steam coal ..... | 2 ft. | 10 in. | ..... | 48 fms. |
| Hutton seam ..... | Good coal..... 4ft. 2in | | | | |
| | Coarse ditto, left 0 10 =5 | 0 | | ..... | 59½,, |
| **LADY DURHAM COLLIERY:—** | | | | | |
| Low Main seam..... | Steam coal ..... | 3 | 2 | ..... | 37½,, |
| | Hutton seam... 4 ft. 2 in. | | | | |
| | Coarse ditto, left 0 8 =4 | 10 | | ..... | 49 ,, |

The intermediate seams, Nos. 2, 3, and 4 above, are found similar in thickness and quality at Sherburn Hill to those of Littletown.

The coal measures are thrown up on the west of Sherburn Hill Pits by a fault running north and south, of peculiar formation; the point of greatest depression on the east side is 37 fms., 1000 yards north of this the depression is 7 fathoms, and 700 yards south of the same point 10½ fms.; the dislocation eventually disappears at both ends.

The Hett whin dyke runs through the southern part of the property, isolating a considerable area to the south of it, which is yet unproved; a great breadth of coal adjacent to the dyke, on the north side, is found so deteriorated as not to be worth getting. A noteworthy feature in the working of these collieries is the extent of the application of engine-power to underground hauling and pumping; as a rule no horses are employed, coal is conveyed from the face to the termination of the engine-roads by small ponies, within certain limits. Gas-works are erected at Sherburn Hill, Sherburn House, and Lady Durham Collieries; gas-lights, derived from these, are used at the bottom of each pit.

Littletown Colliery.—Coal working commenced in 1834. Two pits are sunk to the Hutton seam, 95 fms., each 9 ft. in diameter, 22 yards apart: one as a coal pit and downcast, the other as a special upcast. The Hutton seam has been constantly worked from that period, and is now almost exhausted. The Five-quarter seam is in course of opening out, and that coal is raised to a small extent. The winding-engine has a 30-in. cylinder, 5-ft. stroke, with levers; two 9-ft. flat wire-rope drums. It raises coal with single-decked cages, two tubs in each deck. One plain boiler, 33 ft. by 6 ft., is fired by Juckes's bars. The heapstead and framing, four screens, and elevator, of wood, were renewed four years ago; the original plant had been 32 years in use.

The Littletown pumping-engine, placed at a pit 800 yards north of the colliery, commands the whole drainage of the Sherburn Mines, and has been in operation since 1833. It is now relieved greatly by underground engines, adapted to force water to the surface, at the Sherburn Hill and Lady Durham pits; it is a double-acting non-condensing beam-engine, from the works of Messrs. R. and W. Hawthorn, with 56-inch cylinder, 8-feet stroke, going from three to six strokes per minute, according to seasons, in daytime only: it is now working at five strokes per minute. Water is raised in three lifts—all in the pit—from the Hutton seam, depth 83 fms.; the lowest lift is 26 fms., and 20-in. bucket; the middle lift 26 fms., and 20-in. plunger=95 gallons per stroke; the top lift, delivering at the surface, is 31 fms., with two 16-in. rams=120 gallons per stroke; the stroke is 7 ft. in each lift. The surplus raised by the top lift is made up by feeders from the Five-quarter seam. Calculated at five strokes, the delivery will be 600 gallons per minute. A balance-beam on the surface takes part of the weight of rods from the engine; the greater pressure of steam is required on the top side of the piston. Four plain boilers, 33 by 6 ft., flash-fired, and fired by hand, uncovered, supply steam at 35 lbs. pressure. Each boiler is fired at one end and by a side fire. The fittings to each comprise one safety-valve, one Hopkinson's valve, one float and whistle, one Johnson's whistle, and sludge-valve. The whole of the boilers at Sherburn Collieries are plain, 33 by 6 ft., and have the same fittings as those above.

Sherburn Hill Colliery has been in operation 35 years. Two coal pits are sunk to the Hutton seam, 22 yards apart: the West pit, 9 ft. in diameter, is the downcast; in the East pit, 13 ft. in diameter, though quite free at the bottom, a small portion of air is found to

ascend, owing to its containing steam-pipes. The special upcast, 9 ft. diameter, with chimney built over it, is 10 yards distant from the East pit. The West pit winding-engine, fitted with levers and condensing apparatus, has a 30-in. cylinder, 6-ft. stroke, two 9-ft. flat-rope drums; the latter and fly-wheel are supported by side wall and wood framing. It raises about 300 tons per day of Hutton seam coal, in single-deck cages, two tubs in each deck. The East pit winding-engine, also a lever and condensing one, has a 32-in. cylinder, 5-ft. stroke, two 9-ft. flat-rope drums. It raises about 340 tons of Hutton seam coal per day, in similar cages to the above. Two plain boilers supply both winding-engines at 15 lbs. pressure; each is fired at the end and one side. A range of seven other boilers supply two underground engines with steam, at 35 lbs. pressure; these are each fired by Juckes's patent fire-bars. The boiler-feeder has a 10-inch horizontal cylinder, 18-in. stroke, and 5-in. ram. Another smaller engine is in reserve for the same purpose. Two columns of 9-in. steam-pipes are taken 74 fms. down the East pit to a drift, where they join to one 13-in. pipe, carried to the receiver, from which both engines are supplied.

The West pit hauling and pumping engine, placed in the Hutton seam, 30 yards north of the pit, was built in 1861, by Messrs. J. and G. Richardson, Hartlepool, and the other engines of this type are from the same firm; it has two 32-in. cylinders, placed diagonally, at an angle of 45°, 24 ft. apart from their centres at the base, 5-ft. stroke. The connecting-rods work direct to one crank and shaft; two 6-ft. drums on the shaft, which by means of clutches are made to run either fast or loose, as required. The shaft is wrought-iron, 17 inches diameter, placed on ashlar walls, at an elevation of 12 feet above the base plate. The cylinders are secured to a metal frame-work, attached to one of the walls. This engine works a 9⅜-inch double-acting vertical pump, 3½ feet stroke, from a crank at the opposite end of the shaft, forcing water to an adit 16 fathoms below the top of the pit=75 fathoms of column of 12-inch cast-iron mains, 2½ inches in thickness at the bottom, and 1½ inch at the top. The pump is worked at night only, at the rate of 26 strokes per minute. Calculated at 19 gallons per stroke, it would deliver 494 gallons per minute. This engine hauls from two principal roads—first, on a road nearly level, in a west direction, 1166 yards in length from the pit to the return wheel; also on the south-west road, a length of 1650 yards, at which point the ropes are changed, either for a south branch of 220 yards further or for the west road of 350 yards further. Near the latter point the ropes must be changed again to work another south branch of 800 yards. A return wheel is placed at the extremity of each branch, as both main and tail-ropes are used throughout; 30 tubs are run with each set. An under level stone drift, driven from the East pit, 16 fms. under the Hutton seam, is extended 1140 yards, in a south-west direction; it drains this district of workings without the use of pumps. (It will facilitate acquiring correct knowledge of the arrangements of the several engine-roads if a sketch of each is made as the description is read.)

The EAST PIT HAULING-ENGINE, placed 30 yards south of that pit in the Hutton seam, has one 29½-inch horizontal cylinder, 6-feet stroke, two 6-feet drums on separate shafts, each with a clear front. The pinion is 6 ft., the two spur-wheels 5 ft. in diameter. This engine also raises water at nights—by crank and connecting-rod from the main or pinion shaft—from the under level drift through two staples; a 16-fms. lift of pumps, 12½-in. bucket, being placed in each, and a pumping beam working between the staples. The water raised by these pumps flows to the 9⅜-in. pump at the west engine, by which it is forced to the adit. The East pit engine hauls on two roads; one proceeds from the pit landing (150 yards south) to a distance of 1630 yards from the pit in an east direction, where the ropes are changed to take the sets in either to an east branch 220 yards further, or to go south and east 370 yards further; return wheels are required at each extremity. The other main road proceeds south from the pit landing, for a length of 1550 yards, and then south-east a further length of 1180 yards = 2730 yards from the pit, where a 6½-ft. return wheel is fixed vertically; this road dips inward slightly. Both main and tail ropes are required throughout, 28 tubs are run with each set. The dip in this district is generally south-eastward, so that the water in the east workings runs to the south and east road. On the south-east portion of this road four double-acting vertical force pumps are placed, which effect the drainage of this district. The furthest pump is worked direct from the axle of return wheel at the extremity 2730 yards in; it has 4-in. plunger, 12-in. stroke, forcing to the next pump, about 600 yards further outwards; the latter has an 8-in. plunger, 18-in. stroke, and is worked principally at night time by endless rope, this is effected by running all the rope off one drum, and by means of connecting shackles an endless rope is formed between the pump and that drum. Another pump, 10-in. plunger, 18-in. stroke, is placed at the turn, 1550 yards in, this also is worked at night by endless rope in a similar manner; it forces 10 gallons per stroke out to a point, from whence the water runs to the under level drift. Another pump fixed a little out bye from the last, with 6-in. plunger, 18-in. stroke, is worked during the day by deflecting the rope over a 6-ft. wheel, from the axle of which the pump is worked direct, being in action while the engine is hauling; the water is forced to the same level as the last, so as to flow to the under level drift.

The heapstead and framing, twelve screens, inclined elevator (the first of its construction in the trade), are all of wood, partly the original plant. A portion of the small coal is washed here, for coke making at the ovens at Lady Durham pit. The coal is carried by a stream of water down an inclined trough, 36 ft. in length, 3 ft. wide; six iron plates are fixed at intervals in the length of the trough, the lower ends of which are adjustable to any height required, by cranks and a level; the plates when lifted serve to retain the heavier material while the coal is washed over. This process frees the coal from impurities in a simple manner, the loss in material of 12 per cent., attending it is principally pyrites and shaly matter.

SHERBURN HOUSE COLLIERY.—This was opened in 1844. Two pits are sunk to the Hutton seam, 22 yards apart; one the coal pit and downcast is 12 ft. in diameter, the other is a special upcast, with chimney over it, 9 ft. in diameter. The heapstead and framing, four screens, and inclined elevator, all of wood, have lately been renewed. Small coal is washed here for coke making, by similar apparatus to that described above. The winding-engine has 33-in. cylinder, 5-ft. stroke, cast-iron levers; two 12-ft. flat-rope drums, and fly-wheel; these are supported on side wall and an intermediate ashlar wall. About 200 tons of Hutton seam coal is raised per day with single-decked cages, two tubs in each deck. The engine-house, of stone, has been rebuilt recently. Four boilers supply the winding-engine, and an underground engine with steam at 35 lbs. pressure; one of these is fired by Juckes's bars; three others are fired by hand at the end, and at one side. Boilers fed by winding-engine, with 5-inch pump, 2½-feet stroke. A boiler, worn out, placed vertically, is used as a water heater by passing the escape steam of the engine through it, and affords feed water at 200° temperature.

The hauling-engine, placed in the Hutton seam 40 yards north-east of the coal pit, has two 18-in. cylinders placed diagonally, 3-ft. stroke, acting direct to one shaft, on which two 6-feet drums are placed; these are put in or out of gear by clutches. This engine hauls on a road west from the pit, 300 yards in length, having a return wheel at its extremity; also on the south and south-east road, a length of 1056 yards from the pit to the return wheel. At 350 yards in from the pit a branch takes off to the east and north, 150 yards in length; the dip in this branch is sufficient for the empty tubs to run in by gravity; with this exception the roads are worked by main and tail ropes, 18 tubs are run with each set. At the extremity of the south-east way a 6-in. double-acting vertical pump, 18-in. stroke, is worked direct from the axle of return wheel, forcing water up a slight rise to a pair of pumps placed about 700 yards from the pit; these are two 10-in. horizontal single-acting pumps, 2-ft. stroke, forcing 13 gallons per stroke to the pit, a lift vertically of 90 feet. The pumps are worked at night only by endless rope over a 7-ft. vertical wheel.

LADY DURHAM COLLIERY.—Coal work commenced here August, 1854. The coal pit and downcast, 13 ft. in diameter, is sunk to the Hutton seam. The upcast, 200 yards to the south of it, 10 ft. in diameter, is used solely for ventilation. The winding-engine has 31-in. cylinder, 5-ft. stroke, two 9-ft. flat rope drums; these, with the fly-wheel, are supported on wood framing, house also of wood. About 420 tons of Hutton seam coal raised per day, with single-decked cages, two 8-cwt. tubs in deck. Four boilers supply the winding-engine and an underground engine with steam at 35 lbs. pressure; each is fired by Juckes's bars. The boiler feeder is a 9-in. vertical engine, 4-ft. stroke, which also gives motion to the firing apparatus. The feed-water is heated in a boiler in the same manner as at Sherburn House. Steam is taken down the coal pit to the underground engine by 9-in. pipes; the escape steam is carried to the foot of the upcast in pipes. The heapstead and framing, eight screens, and double inclined elevator, are of wood. Sixty coke ovens, dome shape, are erected near the pit, having main flue and three chimneys of 65 ft. height. Coke of excellent quality is made from the washed coal of the Hutton seam.

The hauling engine is placed in the Hutton seam, 40 yards north-east of the coal pit, of the same type as those before described. Two 20-in. cylinders placed diagonally, 3-ft. stroke, acting direct to main shaft, on which two 6-ft. drums are placed put in or out of gear by clutches. From one end of the same shaft a double-acting vertical pump is worked, with 6-in. plunger, 18-in. stroke, forcing 3½ gallons per stroke to the top of the pit, through 49 fms. of 9-in. mains. These mains were put in large in order that a larger pump might be introduced, which is intended to be done. The 6-in. pump is kept in action while the engine hauls, and also at nights. The engine not only hauls from five different roads, but works four double-acting vertical pumps at various points in the mine, with 6-in. plungers, 18-in. stroke; part of them are always going conjointly with the hauling. Two of the pumps are driven direct from the axles of two return wheels; two others by deflecting the tail-rope under two 18-in. sheaves, and over one 6-ft. wheel. The deflection can be varied in accordance with the pressure required. One engine-road proceeds south from the pit at a slight dip, 440 yards in length to the return wheel. Another, the main road, proceeds west from the pit a length of 1050 yards, dipping the greater part of the length, and afterwards rising inwards. At 170 yards, on the main road, a branch turns to the north, extended about 960 yards in; at its extremity a pump is worked from the return wheel. At 170 yards from the pit the ropes are changed for three roads—the north branch, the main road, and the first south branch. The first south way branches off at 264 yards on the main road; at this point a pump is worked by deflecting the tail-rope. This branch is 430 yards in length. At 572 yards on the main road the second south way branches off; ropes are changed here also to take sets either into the main road terminus, or the second south branch. The latter is 260 yards in to the return wheel, from the axle of which a pump is worked direct. At 792 yards on the main road another pump is worked by deflecting the rope; this forces 3½ gallons per stroke in 4-in. pipes nearly to the pit. The delivery from the four different pumps, working at intervals, is sufficient to keep that at the engine going day and night. Main and tail ropes are used in every part of these engine-roads. The five return wheels are from 5½ to 6 ft. in diameter, placed vertically: 40 tubs are run with each set.

UNDERGROUND WORKINGS AND VENTILATION.

| Colliery. | Circulation. Cub. ft. p. min. | Furnace power. | Depth of upcast. | Diameter. | Number of horses, ponies. |
|---|---|---|---|---|---|
| Littletown | 15,000 | One—9 ft. by 6 ft. | 95 | 9 | 1 .... 11 |
| Sherburn Hill | 78,000 | Two—9 ft. by 6 ft. | 90 | 9 | 3 .... 44 |
| Sherburn House | 35,000 | One—9 ft. by 6 ft. | 59 | 9 | — .... 21 |
| Lady Durham | 70,000 | One—9 ft. by 6 ft. | 49 | 10 | — .... 32 |

The system of working in the whole of the mines is by bord and pillar; the usual size of pillar is 22 by 16 yards; bords, 4; and walls, 2 yards wide. The pillars are removed by driving 5-yard lifts all in one direction, and 10 yards in length. The bords are driven either north or south, as the cleavage in this locality is nearly in an east and west direction. Candles are used in the whole workings, and Davy lamps in the pillar working. The production of gas is but slight. No lives have been lost by explosion during the periods of 36, 35, 26, and 16 years which each colliery respectively has been in operation, neither has any loss of life occurred from ropes breaking or from overwinding, and in other classes of accidents the loss has not been great. Considering the large supplies that have been drawn from the Hutton seam in those periods this is a remarkable result, and indicates that great carefulness must have been exercised both by agents and workmen in its attainment. The principal workshops are at Littletown; several machines for engineering purposes are erected, and saw-mills driven by a horizontal engine.

## THE REGISTRATION AND PRESERVATION OF MINING PLANS AND SECTIONS.

SIR,—I am looking forward with some interest for the views upon this subject which were promised in the Journal of March 11. As it is of the highest importance, perhaps you will allow me space in your next issue to continue my remarks. There are at least four sources from which such plans may be derived—the superior landlord or his agent, and the lessee or his agent; and it would be extremely desirable to learn, through the medium of the *Mining Journal*, what may be the views of other gentlemen holding those respective positions. At the same time, we may hope that other correspondents will consider the question from that point of view which regards our national interests. I must admit that it is one which is fraught with many difficulties. If it be shown that it is intimately connected with the preservation of human life, as I doubt not our Government Inspectors will all be prepared to uphold, there is a very firm ground upon which we may ask for legislative interference, whatever private interests may be threatened. This applies to working plans rather than to pit sections. If, however, we regard it as an element of waste, and consequent national loss, then there are many other branches of mining which should be included in any contemplated legislative interference—such as the method of working, the drainage of mines, and even the letting of mines in small areas. Upon this ground of waste I confess that I cannot forsee much hope of such interference, except some radical change be made in all our laws and customs affecting private property. Thus it can be shown that the very rigid restriction of some mining leases, and what some think proper to stigmatise as the niggardliness of the landlords, not unfrequently lead to waste or loss of coals. But how are we to interfere, unless in order to secure ourselves from a national loss we think proper to make the mines a national property? If we are not prepared with legislative means for preventing the inundation of the greater part of the North Staffordshire coal field, what is the use of talking about the minor forms of waste? Admitting all that has been or can be said regarding the criminal waste, I may say, of the chief source of our national wealth, how are we to avert it? In my opinion the cure will be found in the increased value of the material; and when we have coal at such a price as to make it *worth while* to work it all out, worth while to combine on the part of coal owners to drain the mines, worth while to be thoroughly economical, then we shall arrive at a state of perfect economy.

Speaking as a geologist, no one could more than myself desire to see a registration of all plans and sections, and I have already spoken at meetings of field clubs in favour of their members collecting records of all sections, whether of wells, pit shafts, roadways, railways, or canals, and keeping them carefully registered. It would be one of the greatest helps possible in unravelling the geological arrangement of the strata in a district. It is also a work which most people are capable of, and I feel sure it would increase the zeal of the members if they knew that they were collecting useful information, probably the groundwork in the hands of some skilful geologist at a future time of a true rendering of the geological phenomena in their district. Then as to sections; we have already a sort of voluntary registration in the published sheets of the Geological Survey. There is, I am glad to say, a very laudable ambition on the part of Mining Engineers to have their names associated with the work of the Geological Survey, and seeing that in most districts those gentlemen are recognising the true value of the science of geology, and are organising themselves as societies in which, perhaps, the geological element prevails, it may be expected that new sections may be made public through the Transactions of such societies.

With respect to working plans. Under the Inspection of Mines Acts the keeping of such is compulsory on the part of the lessees or workers of colliery lands, and all prudent landlords of mines, knowing the value of a colliery once worked to depend very much upon the information he can give to future intending lessees, will take care to have copies of such plans, if they be not regularly surveyed and plotted by his own agent. Thus for the future, under the instrumentality of the Mines Inspection Acts, and the advance in mining science, we shall be saved from some of the conditions which contribute to waste. The state of things anticipated by the authorities whose opinions you quote in the Journal of March 11 has undoubtedly happened, and the loss of much coal which might have been averted if plans of the works in those days had been registered, or even made. This cannot be remedied, and I think we may look forward to the increased value of coal, the larger areas of individual collieries consequent upon the greater expense attendant on mining them at double or treble the depth of some of our present workings, to save us from like losses in the future.

Now that the value of statistical information of any kind is acknowledged, and whilst there is a growing disposition on the part of owners and mining engineers to impart all proper information, and especially now it is recognised that the Government are not disposed to employ such for purposes of taxation, it is to be hoped that all we require may be achieved. When it is considered also that the recent test of such a disposition has been made in the enquiry of the Royal Coal Commission, showing that a very enlightened spirit has been manifested in this direction, I think we may trust to it for all information needful for our national welfare. If I am right, then it needs only that a voluntary registration should be attempted, and for this purpose it might be made a branch of the Mineral Statistical department, over which Mr. Hunt now so ably and successfully presides. It is still very desirable to know what other gentlemen, and especially those who are directly connected with mines, may think upon the subject.—*Shrewsbury.* DANIEL JONES, F.G.S.

## OUR OLD SMELTING FURNACES.

SIR,—It would almost appear as if during little more than a hundred years there had been a complete migration of the furnaces from the places where they were then worked, and in the counties where the great bulk of the iron was then made there is now neither coal nor ironstone to be seen. In 1740 the number of furnaces in England was 59, the production of iron about 17,350 tons.

Sussex was then the principal pig-producing county, and had 10 furnaces in blast. Now there is not one within a hundred miles of it. The adjoining county of Kent could also boast of four furnaces, but its pleasant scenery and rich lands are free from those unsightly objects which are not considered as calculated to add to the beauty of a landscape, or to have any particular charm for our painters.

The famous cheese county, Cheshire, most likely had as great a reputation at one time for its "pigs" as it now has for its cows and dairy produce, for it had three furnaces, all of which have long since disappeared, scarcely leaving a trace of their existence behind. Herefordshire, another rural and pleasant part of the kingdom, famed for its apples, its ciders, and its rich pastures for fattening beeves, had three furnaces going, but they have long since gone, in all probability never to return. Worcestershire had two furnaces, but in what part the deponent sayeth not, probably not far from the neighbourhood of Dudley; the exact spot, however, will be known to some local authority on matters antiquarian.

Shropshire, at the time to which we refer, had six furnaces, Coalbrookdale being then a place of considerable importance. For many years before that we find Abraham Darby made pig with pit coal got in the same locality as the ironstone, and the iron then had, as it has at the present time, a high reputation. Gloucestershire had 6 furnaces, but for a long time was without any, but has now some 10 or 11; Yorkshire 6, now about 120; Staffordshire had 2, now upwards of 200 built; Lancashire had none, now between 30 and 40. Derbyshire, which has more than 50 furnaces at the present time, in 1740 had 4. Hampshire had then a solitary 1, but at present it has none, and Nottingham is in the same position. South Wales had 5, 2 at Brecon, 2 in Glamorganshire; in the two there are now about 100. Carmarthen, the seat of extensive copper and tin works, had 1 furnace, but now none. In Denbighshire, North Wales, there was 1, now 8 or 9.

In agricultural counties where furnaces formerly flourished, the iron in nearly every instance would be made of charcoal, there, no doubt, being plenty of timber for that purpose. The making of pig by the simpler means of coal must ultimately have led to the furnaces being erected near to the pits, as it is probable the forests became rapidly denuded, whilst the stone in the neighbourhood of the coal fields gave a great advantage to those working it where both were found. FERRUM.

## NEW PHOSPHATE ROCKS.

SIR,—Nothing is more deceptive than the appearance of a Phosphate rock. As an ingenious Frenchman said of other things, "they resemble nothing at all." When a mineral mass of some extent is met by enterprising miners it should be carefully examined. A rock or deposit may be looked upon as marl, chalk, sandstone, &c., when in reality it is nothing more nor less than phosphate of lime, worth 4*l.* or 5*l.* per ton, perhaps more.

Some years ago a friend who was travelling in the South of England sent me a piece of fossil tree, which was deemed so curious that I was allowed to pay the carriage of the specimen. It was indeed a curiosity, and, as my correspondent told me there was abundance of similar specimens in the neighbourhood, I published the analysis of it. This piece of fossil tree was entirely formed of phosphates, though, at first sight, it would have been taken for an ordinary petrifaction, and set down as so much silica or flint. No doubt the locality in which this and other similar fossils were found must be rich in phosphatic deposits.

Since the discovery a few years ago of the curious dark-coloured phosphatic rock in North Wales nothing new in this way seems to have been forthcoming in England, though we have found in these islands a vast quantity of phosphatic material, and perhaps we should not complain. Have we not the Cambridge coprolites, the Suffolk coprolites, the Bedford coprolites, the Speeton coprolites, the Black Fen coprolites, &c.? Besides these, we find in commerce Sombrerite from the West Indies, Navassa phosphate, Estremadura phosphate from Spain, Apatite from Canada, German phosphate, and, latterly, Baltimore phosphate and Charleston phosphate. Of the two last, I have a few words to say:—Baltimore phosphate does not seem to be very often offered for sale—at least, it is not sent to be analysed. It is a very curious mineral—light greyish brown, porous, very fragile and dry, rich in phosphoric acid, and containing combined water, but little moisture, and little or no lime. A sample analysed in my laboratory gave:—

| | |
|---|---|
| Combined water | 23·0 |
| Phosphoric acid | 40·0 |
| Oxide of iron and alumina | 31·0 |
| Lime | Trace. |
| Sand | 6·0=100·0 |

This sample was taken from a very large bulk. From the above composition I conclude that it is a sesquiphosphate of iron, combined with twelve equivalents of water, and containing a little phosphate of alumina.

Of the Charleston Phosphate there was an interesting account in the *Mining Journal* of March 18. It occurs in South Carolina, and, according to the analysis of an average sample (?) quoted in that article from a pamphlet by the well-known geologist Prof. Holmes, it would consist of 6·225 of moisture and 28·874 of phosphoric acid, or upwards of 63 per cent. of phosphate of lime. Let us see what the composition is when it arrives at Liverpool, in this country. I have found in a sample from a large number of tons offered for sale:—

| | |
|---|---|
| Moisture (a little) and bituminous matter | 8·0 |
| Phosphate of lime, with a little phosphate of iron | 57·6 |
| Carbonate of lime | 15·4 |
| Sand | 19·0=100·0 |

You will see by this that the composition of the rock as it arrives in this country is rather different from that I have just quoted—and, moreover, in that analysis, the extreme accuracy of which is pushed to the *third* decimal (when no chemist in the world can be certain of the *second*), no allusion is made to 15 per cent. of carbonate of lime and 19 per cent. of sand, which are quite overlooked. The Charleston phosphate is on a par with our Cambridge coprolite (but contains rather less carbonate, which is an advantage to the manure-maker), and, like the latter, will be a valuable adjunct to agricultural enterprise. I have heard it stated that our Cambridge supply is running short, but do not know how true the statement may be; nevertheless, I cannot let this opportunity pass without calling the attention of our practical mining men to the importance of having any peculiar rocks or de-

posits which may be unknown to them, and exist in notable quantities in their setts, subjected to the test of chemical analysis. There are other things in heaven and earth, &c., besides phosphates. Uranium ores and bismuth have sometimes been met with very unexpectedly.

T. L. PHIPSON, Ph.D., F.C.S.,
Professor of Chemistry.

*Analytical Laboratory, Putney, S.W.*

## STEEL MANUFACTURE.

SIR,—In the Journal of March 11 I see that, under the head of "Reactionary Process of Steel Manufacture," I am classed with Clouet, Uchatius, and others with having failed to decarbonise cast-iron so as to produce steel, and to having abandoned the process as impracticable. Now, I have had this process in successful operation for 21 years past, and I am producing by it steel which is pretty well acknowledged to be the best steel ever produced, and which is most successfully adopted by many eminent firms as far superior to any steel which the combined talent, energy, experience, and wealth of the Sheffield steelmakers has succeeded in bringing into the market. Of course, I am well aware that Clouet, Chalut, Uchatius, and Hassenfratz merely made a nine days' wonder each of processes utterly devoid of practical utility, and, in some instances, as absurd as they were useless; but as long as I made by my reactionary processes steel which no Sheffield or other steel firm has been able to rival, I really do not wish to be classed with the above excellent gentlemen, or to become identified with their acknowledged failures. As to the Martin process I do not know what it is. The melting of pig-iron in an open hearth, with addition of malleable scrap, might reasonably be called the Sanderson or the Attwood process, as both these gentlemen had anticipated all that is not arrant nonsense (and that all is very little) in the Martin claims.

The regenerative furnace, which alone enables the open hearth furnace to be practically utilised, is the invention of Mr. Siemens, and ranks as an invention second alone to the Bessemer invention. As regards the thing called spiegeleisen, which they have now succeeded in producing in Rhenish Prussia, it is such an impure debased product, as compared with the spiegeleisen which was made 30 years ago, that it is no wonder we hear complaints of the irregularity of quality prevailing in steel with which this very inferior spiegeleisen now made has been alloyed: 1 cwt. of the former genuine spiegel was fully as effective as 5 cwts. of that now sold in the market. The spiegeleisen produced in the blast-furnaces of the Ebbw Vale Iron Company in 1856 was very superior in quality to that at present imported from Rhenish Prussia, and I am surprised that that company should only recently have resumed the manufacture of this valuable species of iron.

Now, as regards the assertion that the open hearth process removes from the materials melted therein two-thirds of the sulphur and three-fourths of the phosphorus, it is an assertion utterly repugnant to common sense, and in direct opposition to practical results. The wholesale extraction of sulphur and phosphorus from pig-iron was reserved for Mr. Sherman, and the laws of chemical equivalents at once gave way, to permit the free use of Glengarnock pig-iron in the Bessemer converter, not *cum grano salis*, but with a pinch of iodine. Messrs. John Brown and Co. seem to have befriended Mr. Sherman at a pinch, and have not gainsayed the marvellous statements put forth of results obtained at the Atlas Works. The "Jones Steel Pig," whose squeak some years ago resounded through the Cleveland district, must now cede the palm of victory to the "Sherman Steel Pig." As every dog is said to have its day, so probably each steel pig, whether of Jones or of Sherman, must occupy its nook (I had almost said "stye") in the temple of fame; and when Mr. Sherman, with his steel pig, and the star sprangled banner which over it waves, returns to the land of the free and the home of the braves, may the squeak of this pig put to silence all knaves.

R. F. MUSHET.

*April* 10.

## ON THE ORIGIN OF METALS AND MINERALS.

SIR,—When our planet was first created and launched in space it would consist of solid matter containing the elements of metals and minerals, and gases; the latter surrounding the solid mass or nucleus. The heat of these elements would at this time be great, probably arising from motion and chemical action, and not from fire, which is a consuming rather than a producing element. When this heat began to abate the gases would be converted to AIR, WATER, and SOLID MATTER.

I am inclined to think that the globe will be less dense as we penetrate below the surface, for the hotter the mass is the more rarified it will become. The weight assigned to the earth by astronomers indicates that the globe is either hollow or filled with rarified matter, for if it were solid, filled with dense matter, it would be ten times heavier than the astronomers say it is. The peculiar shape of the earth, being flattened at the poles, and swelled out at the equator, which no doubt arises from its rotary motion, is the proof that at first our globe was soft, or it could not have taken that shape—a fact that is amply confirmed by the appearance of the rocks themselves.

All the rocks without exception appear to have been formed under the sea. We are constantly apt to overlook this simple fact, and by forgetting it we find difficulty in accounting for their formation, for it is impossible to conceive how they could have been formed in any other way. In now proceeding to trace the history of the rocks, I shall divide them into six distinct epochs.

THE GRANITE PERIOD.—Granite and mica schist are composed of three distinct substances—feldspar, mica, and quartz. As these minerals are not fused or amalgamated, it is plain that these rocks are not of igneous origin. The feldspar has been extracted from the gases surrounding the earth at its first creation, and so have the mica and the silica. Coatings of these substances would completely cover the earth's surface, and be the first strata to be operated on by the sea. Such is the probable origin of granite, which has hitherto so much puzzled geologists to explain. The metamorphic rocks must have been excessively hot and soft when first deposited, and for ages afterwards, for we find them forcing themselves up to the surface through the Devonian rocks, of which the elvan courses are an example. The rotation of the earth on its axis, and the periodical changes of temperature owing to the motion of the earth, cause currents in the sea, and winds in the atmosphere. The winds and currents produce inequality in the surface of the globe, which at this time is entirely covered by water. They scoop out vast valleys on the one hand, and raise up great ranges of hills on the other hand, at the bottom of the ocean, and in this way the granite and other metamorphic rocks are deposited.

THE SLATE AND DEVONIAN PERIOD.—The currents continue to scoop out the rude matter in the valleys of the ocean, which is absorbed by the waters, and deposited in a sedimentary form on the hills, on the top of the granite. In the process of cooling this sedimentary formation must have cracked in all directions, and the fissures thereby formed are filled in with silica and metals drawn from the air, water, and the surrounding mass, and such is the probable origin of the mineral veins. Chemical action and electricity have been the great agents employed in crystallising the rocks and forming the metallic substances they contain. While most of the mineral veins have in all probability been filled in from the top, there are others which may have been sprouted up from below or extracted from the surrounded mass.

THE LIMESTONE AND CARBON PERIOD.—The mountain ranges now emerge from the sea, and become dry land. The waters have now scooped out so much room for themselves that the sea level is greatly reduced, and the mountains are left dry. Portions of these highlands are washed down into the sea, the debris of which is absorbed by the waters, and mixed with fresh supplies of rude matter from the valleys of the ocean are deposited in a sedimentary form on the plains under the sea. These are the stratified rocks, forming beds of freestone shale, limestone, ironstone, fire-clay, and such like.

The atmosphere and sea are at this period quite different from what they are now. The air is warm and thick, being impregnated with many substances which it does not now contain, and the same may be said of the water, which is warm and contains a variety of minerals now not to be found in it. When a bed of freestone or limestone is deposited it is produced in this way. By means of electricity a precipitation takes place, and the sediment so produced is the bed of freestone or limestone. The stratified rocks are, therefore, entirely formed out of air and water. It is generally supposed that these rocks must have taken ages to form, but when we remember that they have been precipitated by chemical action under the sea no such idea need be entertained, for they may have been produced very rapidly. Land plants and animals are occasionally found buried in these rocks, as in the coal measures, and still more plentifully in the oolite series, but it does not follow that any of these rocks have been formed on dry land, for these deposits were not made when the land plants and animals lived, but only after they were destroyed.

THE OOLITE AND CHALK PERIOD.—The currents continue to scoop out the rude mass in the bottom of the ocean, and that combined with the debris of previous deposits is precipitated under the sea on the top of the carboniferous formation, and forms the lias, oolite, and chalk formations. As the animals of this period are chiefly amphibious, it is probable that the land at the time was low and only partially delivered from the dominion of the sea.

LONDON CLAY AND RECENT DEPOSITS.—These rocks, like the others, precipitated under the sea, derive their origin from the debris of previous rocks in connection with the rude matter at the bottom of the ocean. The result of these latest formations is a permanent reduction in the sea level, a great purification of both air and water, and a striking fall in the temperature of both. The remains of tropical animals being found in Greenland and Lapland, where these animals could not now exist indicate a great fall of temperature.

THE NORTHERN DRIFT.—What caused the great floods which swept over the habitable globe at this time is impossible to say. Possibly the Arctic ocean was at this time a vast lake surrounded by mountains, and when the sea level of the outer ocean was reduced in the London clay period, the support of these mountains was taken away when the water of the Artic sea broke loose at Beering's Straits and Spitzbergen, and deluged the whole world, an idea which may have given rise to the name of *Northern Drift*. This catastrophe carried away vast districts of dry land covered with stratified rocks, and deposited the debris on the sea coasts in all quarters of the globe, these deposits being known as the Northern Drift. Although this deluge must have passed over the greater portion of the globe, for it destroyed nearly the whole of the animals on the face of the earth, it does not appear to have occasioned any great rise of the sea level, unless we suppose the habitable globe to have been much larger than it is now.

THE PRESENT PERIOD.—The sea now covers two-thirds of the surface of the globe, and the land one-third. The unstratified rocks cover about one-fourth of the land, and the stratified rocks about three-fourths. The air and water are now so pure that they are unable to precipitate any more rocks except very gradually, and the bottom of the sea has become so hard, owing to the reduction of the temperature of the water, that the currents cease to cast up those vast quantities of stuff they formerly did. We, therefore, fail to perceive almost any changes going on in the respective domains of sea and land, as was the case in the geological periods that are past.

None of the rocks seem to have been produced by fire, with the exception of basalt, lava, and such like, the produce of volcanoes. Volcanoes, no doubt, are fed from inflammable gases issuing from the rocks in their vicinity. For 20 miles round Naples the rocks are quite warm a few feet from the surface, showing plainly where the fire of Vesuvius comes from. It comes from near the surface, and not from the centre of the earth. The lava produced from volcanoes is probably the metamorphic rocks melted.

The mountain ranges present the appearance of so many rows of mole-hills in a field, as if they had been thrown up from below, but that form has no doubt arisen from the heat and fermentation of the deposits themselves, and not from any force from below these deposits. The same may be said of the plains where the stratified rocks occur in an undulating country. The undulations have been caused by the fermentation of the sedimentary deposits in the process of cooling. The breaks or slips in the coal measures are very numerous, and have no doubt arisen from the cause I have mentioned, and not from up-heavings from below. In proof of this, I need only say that the slips in the Old Red Sandstone below the coal, and in the New Red Sandstone above it, are not nearly so numerous as in the coal measures, and if the slips come from below they would be the same all through.

Having described the rocks on the land, let us now turn to the bed of the ocean, and try to imagine what it will contain. We find the land covered with mountains, valleys, and rivers, and if we could draw off the waters from the sea we would find the bed of the ocean present a similar landscape to that of the land. There will, of course, be no rocks, either stratified or not, in the valleys of the sea, only the rude mass of the earth, but on the hills we should find unstratified rocks, and on the plains stratified rocks. The gulf stream is an example of a river in the sea. The general currents of the Atlantic are from east to west, and in the Mexican Gulf that flow is stopped by the land of Central America, which causes the waters to flow back in a northerly and easterly direction. In California the gravel deposits that are being worked on the hydraulic system of mining may be considered the beds of marine rivers. They are often several miles wide, and situated high up on the hills. That these salt water were rivers there can be no doubt.

It has often puzzled geologists to account for the limestone and carbon found in the stratified rocks, as these substances are almost entirely wanting in the primitive rocks, but when we consider that the currents of the ocean are always digging deeper and deeper into the rude mass the difficulty is explained, for that which was not reached at an early period is laid bare at a later period. The gold, silver, copper, lead, and other heavy metals came first, after that iron and the lighter metals.

Such is a brief outline of the physical history of the globe, which I hope may not be uninteresting to your readers. An eminent theologian has said that if we could only see behind the scenes all nature which now appears so complex and incomprehensible would then be plain and simple, and I trust the truth of this remark may yet be demonstrated. Mr. Darwin, Prof. Huxley, and others are doing good service to science in trying to discover the origin of animated nature, and it is no less desirable to make similar discoveries in inanimate nature. Should the present letter lead to a discussion of this highly interesting and important subject it will be a step in the right direction.—40, *Elgin-road, Bayswater.*

A. ALISON.

## SCIENCE AND THE EMPIRIC ART INSEPARABLE IN MINING.

SIR,—A great deal is said about Scientific Mining as contradistinguished from Practical Mining. What are the principles of science, it may be asked—if any—which underlies it? Human experience, like the globe we inhabit, is made up of particles, each having a distinct relation and bearing to the others. These relations and bearings are subject to certain influences or forces, differently distinguished and understood, according as their survey is general or partial, generous or contracted.

The atoms which compose the globe enter into a variety of combinations and forms, each possessing some distinguishing characteristic. Yet not always externally visible nor determinable. In such cases where individuality merges into the complex character—the mass—and baffles the ken of human unaided vision, to the analyst it is clearly demonstrable that without this or that specific individual constituent the compound mass could not be what it was, but must have been something else, although form, feature, and colour were identical. In some such way mining is inseparable from and underlies human progress, and is essential to advanced and advancing civilisation. It is more than an atom, however; it is a combination of atoms, or branches of knowledge drawn from and fed by a variety of sources, and applied to one object primarily, either directly or indirectly, as circumstances may determine—that is to say, borrowed auxiliary rules are applied directly as borrowed, or are modified for purposes of adaptability to their new application. The object being in all cases the same,—to economise labour and expedite results.

Science, it is said, is the attainment of knowledge by precepts, logical, inductive, and mechanical. And in the systems pertaining to the exact sciences such knowledge is esteemed to be demonstrably correct. It has been asked what are the principles of science which underlie mining, and here it may be as well to reply that it is underlain by none of them; its foundation is in nature, though both science and art aid and minister to its development. Mining embraces an aggregation of the sciences as well as of the arts, empirically applied. This is both obviously and necessarily so, and hence skill, instead of art, has been applied designatory of mining.

Science has ever held a distinguished place in the world's history, and deservedly so whenever it asserted itself on proper principles. But to how much greater extent has the empiric art prevailed—that is art subject to modification at the will of the projector, instead of by definite rules, as in the manufacturing or mechanic arts. The fact that the principles in science which become the rules of art are frequently inapplicable with anything like uniformity in mining, and that throws the miner to a considerable extent on his own resources, and constitutes his profession unique or singular.

That Mining is neither a science nor an art is because of its complex nature, its extensive ramifications, embracing both in so eminent a degree; and because no set of rules can be framed for its conduct which may be correctly applied in any two districts alike. Rules are eliminated by experience which no abstract propositions of science could ever determine; and thus it not unfrequentiy happens, as regards mining, that what is demonstrated to be true in one instance, or one district, is reversed, and consequently inapplicable, in another, and that, too, without any adequate cause perceptible to the mind of an observer.

Empiricism and science in their relation to mining appear very much like two contiguous rocks in the geological scale, which at some points the line of demarcation between them is unmistakably clear, whilst at others there is an imperceptible gradation of one into the other; so that no human penetration could possibly determine where one ends and the other begins, so decided is the reciprocity, so intimate the blending. The empiric art in mining theorises from local considerations mainly, at the same time it rests principally for results on individual perception and judgment as to similarity of things present with things past, and the adaptive power of the individual mind to compass ends by devise and application of means. Induction characterises its theory, whilst analogy modifies and controls its practice. The facts upon which analogy reposes are facts of experience, and as such become the treasure of the practical mind, over which it too frequently exercises an exclusive ownership, unless associate circumstances are such as to demand their evolution, and consequent dissemination. Thousands of valuable facts of experience serve but to enlighten a single mind, because written on no other tablet, and its rays being never thence reflected. Science, on the other hand, frames abstract rules for the acquisition of knowledge when established rules do not apply, and endorses the responses of the operations of such rules as scientific truth. It must be admitted, however, that scientific truth is not always truth absolutely. It is sometimes merely relative, as means to an end, as cause and effect, &c. In logical and inductive science certain propositions are laid down as facts, and certain other facts are educed or deduced therefrom. It must be admitted, therefore, that in proportion as the propositions are correct or otherwise will be the resultant facts. But all the facts of science, it is well known, do not depend on logical deductions nor inductions for force or effect; the physical sciences are susceptible of more tangible results, regarding only effects as the issue of certain adequate and recognised causes; and these are they which enter more prominently into the domain of practical mining, and identify themselves inseparably with its history. Induction, therefore, is an element in its theoretic compositions which at once yield to facts of experience, when those become established, and theory in respect to such facts at once and forever ceases.

An error to which mankind are very liable when light dawns upon a truth is to begin its elucidation at the wrong end, or in the wrong way. Sometimes by attempting to separate essential parts of the same thing, and to set in independent motion things which can only obey reciprocating influences. A similar error has been committed by attempting to eliminate harmonious responses by an arbitrary union, or union by forces of heterogenous elements, having no affinity for each other, and the tendency of whose natural aptitude is to gravitate transversely or diversely to each other, and hence can never act in the same plane and escape collision. In a similar manner things mutually subservient and naturally co-operative, but misdirected by unskilful hands, have come into violent collision, and great injury has been done in the retardation of progress of vital industries, of which mining is one, and not the least.

It will not be forgotten, I think, by many of your readers the upstart days of geology, when many of its abettors vaunted themselves as if they had found the philosopher's stone, not that they could transmute the base metals, or professed to do so, but something which was akin to that, and equally extraordinary. They affected—nay, they affirmed—that by certain "improvised" rules, as arbitrary as they are abstract, and equally ideal, to be able to point out and define the major and minor metalliferous deposits, with such certainty that mining under their regime would at once and forever cease to be a speculation, if committed to their practical control. Here, as is often the case, coruscations of light were mistaken for the body emitting it, and that liberality, or charity, attendant on and inseparable from a comprehensiveness of knowledge, was absent or inoperative, because lacking its legitimate foundation. The inflation of vain minds allowed of no room to examine into the causes which regulated and controlled the destinies of life's practical affairs through the past ages of time. It seemed never to have recurred to them that all the facts of geology relating to mining were recognised and applied with as much certainty before as after the inauguration of that beautiful and instructive science. There is one thing it did, however: it systematised by its classification of the rocks the recognised facts of geology as affecting mining, and gave to the world a nomenclature which the miner availed himself of, and hence a common platform, so to speak, was provided, on which the scientific and the practical man may meet and discuss in mutually intelligible language the beauties and wonders of their allied science. This is as it should be; the true sphere of science is in its ministrations to art, and art is inseparable from all practical pursuits involving thought, and hence by its modified term "skill" in mining resolves itself into knowledge applied, which, as respects mining, must remain to be regulated by the exigencies and condition of things, as presenting themselves to the individual judgment.

That mining should be abstruse to the generality of men follows from the nature of things. The interior of the earth, from its surface downwards, is still to us comparatively a sealed book. As yet but little is known of the operations of Nature above ground, still less of the laws which obtain in her subterranean recesses, and with which the miner more particularly has to do.

It requires a diversity of knowledge to constitute good mining; yet much relating thereto may be acquired by the ordinary rules of art. After all there remains the most important, which no precepts can ever supply—that nameless something, akin to intuition, which apprehends more than comprehends the vital action of the earth's stupendous mechanism, and that too with a distinctness similar to that with which it would observe in dim outline a moving panorama. Such discrimination and comprehensiveness of observation can only be obtained by close application of a well balanced mind, aided by the light of science and philosophy. To constitute a perfect miner, in the ideal sense of the term, would involve a knowledge almost of the whole circle of the sciences,—certainly the more difficult of them, such as natural philosophy, logic, mathematics, experimental or chemical science, and the mechanical, including crystallography and mineralogy, besides several others.

It may or may not be unfortunate that many of the principles of science are found inapplicable in mining, and hence experimental philosophy can only obtain. The same may be said of experiments in mining—prospective mining—which are inseparable from a large outlay, expenditure of time as well as of money. It, however, devolves on the mining engineer to assume some amount of prescience—to see, so to speak, the end from the beginning, and select and adapt means to compass it accordingly, notwithstanding he be sometimes, and not unfrequently, surrounded by a wilderness of events marked by no human footprint practically, and where chaos only seems to reign supreme. There is encouragement even here; there is no walk in practical life unattended by light, nor unattainable by man. The axiom which affirms the impossibility of a man knowing everything admits inferentially the possibility of his knowing many things. One thing is indisputably clear to an ordinary observer—the world moves on, and in the present day with seemingly accelerated motion. Its revolution and the revolutions of current contemporary events

repeat themselves, and exhibit the same thing on many sides during a lifetime, consequently the individual or system which do not move in harmony with the general mass must of necessity, by remaining stationary, become fossilised and isolated from elements they were intended to aggregate with, and instead of increasing retard their momentum.

What appears to be required of mining is to deduce a theory from its varied practice, in contradistinction to other systems which resort to practice from theory, so that it may be characterised by some literary element of its own. This seems to be demanded more from caprice, external or extraneously, than from any inherent necessity in the thing itself; so that it may be said to keep pace with the march of events. The difficulties and dangers besetting the proposed change only suggest themselves to the thoroughly practical and experienced class. From this it will appear that the science, or the "skill," of mining will remain, as heretofore, the property of the closely observant mind, which by assiduous application makes inself master of the kindred sciences which facilitate its progress and development, the application of which as to time, measure, and intensity will, we predict, forever remain, as now, to be regulated and controlled by its individual judgment. To store the mind, therefore, with sound practical knowledge, supplemented by observations of Nature's handiwork in the mineral kingdom, and permitting it to mould its ideas conformably to received impressions, and independently of any arbitrary action of the will, uncomformable to reason, is certainly the best preparation for the conduct of mining—schoolmen to the contrary notwithstanding. ROBERT KNAPP.

*Ellsworth, Nye Co., Nevada, March* 8.

## ON THE DRESSING OF ORES—No. V.

### SIZING APPARATUS.

SIR,—When the separation of mineral substances is to be effected by taking advantage of their specific weights in water, it is of the highest importance to operate on grains as nearly as possible of the same size, as otherwise the surface of one particle in proportion to its density will, in a measure, compensate for the greater weight of another. In order to secure the necessary dressing conditions sizing must be employed, but the ratio in which the stuff should be divided is governed by the difference between the velocity of fall due to one substance and that of the other to be separated. Bodies of varying size and specific gravities, but possessing equal velocities of fall, resolve themselves into equivalents, and cannot be isolated by any water or mechanical treatment whatever. It is, therefore, essential for the purpose of separating stuff in water that the velocity of fall of one mineral exceeds that of another—in other words, that bodies of equal size bear different densities.

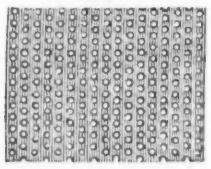
When the velocities of the fall of ore and the associated gangue differ in a great degree, then the number of sizing and classifying divisions may be few; but when the specific gravities of several veinstones are closely allied to each other then the classifying arrangements must include a greater number of subdiving parts. The integrity of this principle should be strictly adhered to without multiplying the number of classifications beyond what may be necessary for economical purposes. Too great a refinement in the division of stuff will involve needless complications in the machiney, as well as undue cost for plant; on the other hand, neglect of the fundamental principle of sizing will most certainly entail unnecessary cost in dressing, and loss of ore in castaways.

In carrying into effect the mechanical concentration of ore the object should be to get rid of as much waste as possible at the commencement of the process, and to limit the quantity of stuff for the slime machinery. In most cases it will be found much more advantageous to part with one unit of ore in the initial castaways than to incur this loss after a finer subdivision of the stuff. The ore should also be dressed to such a percentage that the cost and loss in smelting should not, as it were, be materially benefited at the expense of cost and loss in dressing. Over dressing, as much as under dressing, should be avoided. But, whatever may be the structure of any given ore, or the distinguishing character of its vein-stone, or what ever circumstance may be connected with a particular ore-producing property calling for special modes of treatment and appliances, the sizing process cannot be avoided—it must be accomplished whether by the direct and certain method of sizing plates and classifiers, or by the indirect and wasteful one of "stripping" the stuff into various subdivisions.

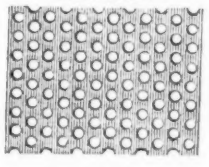
Before entering upon the description of sizing apparatus it is desirable to give a passing notice to perforated plates, which of late years have become so common, yet are so marked a feature in German dressing arrangements. The plates are made either of charcoal iron, puddled steel, cast steel, copper, or brass. The dimensions vary with each metal, and with the thinness of the plates themselves. Plates perforated with holes from ½ millimetre to 1 millimetre are about 3 ft. by 2½ ft., whilst holes of greater diameter are made in plates 6 ft. by 3 ft. Small holes from ½ millimetre to 1 millimetre require to be made one diameter apart; holes exceeding these dimensions may be closer together; above 5 millimetres diameter the distance need not exceed one-third of a diameter. The holes in the German sizing-plates are strictly round, free from burr, and, when required, are slightly conical. For sizing stuff from ½ millimetre to 1 millimetre copper or brass plates are often employed. Stuff from 1 millimetre to 50 millimetres is separated on plates of iron and steel. The holes run from ½ millimetre, or 1-50th part of an inch, to 50 millimetres or 2 in. in diameter. From ½ millimetre to 3 millimetres the diameter of the holes advances with a difference of ½ millimetre; from 3 millimetres to 13 millimetres the increase is ½ millimetre between sizes, whilst from 13 millimetres to 50 millimetres it is 1 millimetre. The cost of these plates increases with the character of the metal employed and closeness of the perforated holes; the wear is dependent on the abrasive power of the stuff, freedom of water from metallic salts, and, to some extent, upon the quantity of metal left between the holes.

Figs. 1 to 7 illustrate portions of plates perforated with holes, 1 millimetre, 2 millimetres, 3 millimetres, 4 millimetres, 5 millimetres, 7 millimetres, and 10 millimetres diameter. These holes give a distinct idea of millimetre measurement, now invariably used on the continental dressing-floors in defining the size or dimensions of stuff:—

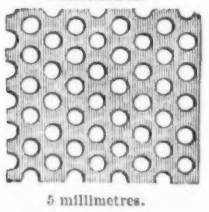
1 millimetre.



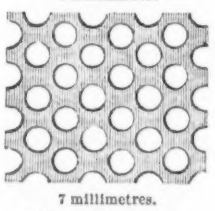
2 millimetres.



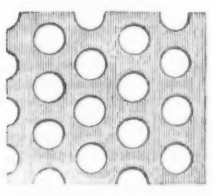
3 millimetres.



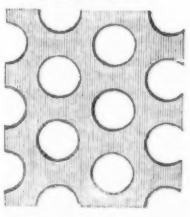
4 millimetres.



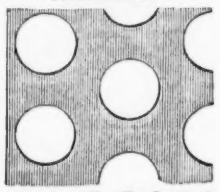
5 millimetres.



7 millimetres.



10 millimetres.



The subjoined table, No. 1, will afford all the particulars which can be given relative to thickness, weight, and measurement of plates pierced with holes ranging from 1 millimetre to 50 millimetres diameter:—

TABLE No. I.

| Iron or Steel Plates. | | | | Copper or Brass Plates. | | |
|---|---|---|---|---|---|---|
| Diameter of holes in millimetres. | Thickness of plate in millimetres. | Approxim. weight of plates per square foot. | Maximum size of plates. | Thickness of plate in millimetres. | Approxim. weight of plates per square foot. | Maximum size of plates. |
| ½ | — | — | — | 5/8 | ·6 lbs. | 4 × 3 ft. |
| ¾ | — | — | — | ¾ | ·8 ,, | |
| 1 | ¾ | ·7 lbs. | 3 × 2½ ft. | 1 | 1· ,, | 5 × 3 ft. |
| 1¼- 1½ | 1 | 1· ,, | 4 × 2½ ft. | 1⅛ | 1·1 ,, | |
| 1¾- 2 | 1⅛ | 1·3 ,, | 4 × 3 ft. | 1⅜ | 1·2 ,, | |
| 2¼- 2½ | 1⅜ | 1·5 ,, | 5 × 3 ft. | 1¾ | 1·5 ,, | 6 × 3 ft. |
| 2¾- 3 | 1½ | 1·7 ,, | | 2 | 1·6 ,, | |
| 3¼- 4 | 1⅝ | 1·9 ,, | | 2¼ | 1·8 ,, | |
| 4¼- 5 | 1¾ | 2· ,, | | 2½ | 2· ,, | |
| 5¼- 7 | 2 | 2·4 ,, | | | | |
| 7¼-10 | 2½ | 3· ,, | 6 × 3 ft. | | | |
| 10¼-15 | 2¾ | 3·2 ,, | | | | |
| 15¼-25 | 3 | 3·5 ,, | | | | |
| 25¼-50 | 3½ | 4· ,, | | | | |

The perforated plates referred to are employed in various ways for sizing stuff, sometimes as a group of flat-bottomed sieves, in connection with cam movements, but more frequently they are formed into drums or trommels. Of late years the system of trommel sizing has been greatly extended, and a variety of trommels produced, each for some distinctive object, or to secure some special advantage. These will be adverted to in the next paper. The German definitions for stuff on the dressing-floors have no fixed and equivalent expression among our British miners; we must therefore, be content to employ terms of an indicative rather than of a determinate character. The designation, therefore, of stuff from 0 millimetre to ½ millimetre is slime sand; from ½ millimetre to 1½ millimetre, fine sand; from 1½ millimetre to 5 millimetres, coarse sand; from 5 millimetres to 10 millimetres coarse grain stuff; and from 10 millimetres to 50 millimetres, rough stuff.

Slime sand—0 millimetre to ½ millimetre, is divided by means of classifiers, whilst products ranging from ½ millimetre to 50 millimetres are sized by the use of flat sieves or trommels. Slime sand is usually treated in buddles or on tables, fine sand in buddles or jiggers, coarse sand and coarse grain stuff in jiggers, and rough stuff partly in jiggers and partly disposed of by hand-picking.

The size of hole usually employed for ores complicated in composition is—for rough and coarse grain stuff—15, 10, 7½, and 5 millimetres; for coarse sand—5, 3, 2, and 1½ millimetres; and for fine sand—1½, 1, ¾, and ½ millimetre. In practice, other divisions are employed, as will appear evident from a perusal of table No. 2; but in each mine it will appear that the sizing numbers approximate to those already stated, the difference being, perhaps, in some measure, due to the necessity of enriching ore associated with gangue, in which there is but little difference in the velocities of their respective falls. The whole of the figures in the subjoined table are in millimetres:—

TABLE No. II.

ANGLEUR, Belgium (lead glance, blende, and iron pyrites).—25, 20, 18, 16, 12, 10, 8, 6, 5, 4, 3, 2, 1, ½.
COMMERN, Prussia (lead glance and quartz).—To crusher, 18-10; to jiggers, 8, 6, 4, 3, 2, 1; buddles and tables, ½-0.
WILDBERG, Prussia (lead glance, carbonate of iron, and quartz).—Picking tables, 25-16; to jiggers, 10, 6, 4, 3¼, 2; to fine sand jiggers, 1¼, ¾, ½; to buddles and tables, ½-0.
LOHMANSFELD, Prussia (lead, glance, blende, copper, and carbonate of iron).—To jiggers, 20, 15, 10, 5, 3, 2; to stamps, 1; to jiggers and shaking tables, 0-1.
ALLTGLUCK, Prussia (lead glance, blende, and carbonate of iron).—To jiggers, 16, 12, 9, 6, 4, 3, 2; to tables, 1, ¾-0.
BAD EMS, Prussia (lead glance).—To picking-table, 30-20; to jiggers, 13, 9, 8, 5, 3, 2, 1; to tables and buddles, ½-0.
BERZELIUS, Prussia (lead glance and blende).—10, 8, 6, 4, 3, 2, 1, ¾.
ISERLOHN, Prussia (calamine, lead glance, &c.)—To jiggers, 18, 13, 10½, 8, 6, 5, 4, 3, 2, 1, ¾; to tables, ½-0.
Mine in LINARES district, Spain, per Mr. Sopwith (lead glance).—To jiggers, 10, 7, 5, 2¼; to buddles, 1½-0.
BURRA BURRA, South Australia (carbonate of copper, quartz, ferruginous clay).—To jiggers, 18, 13, 10, 7½, 5, 3¼, 2, 1¼, ¾; to fine sand jiggers, ½, ⅓, ⅙.

*Coleman-street-buildings, London.* JOHN DARLINGTON.

## ORE-DRESSING—No. III.

ROLLS.—The next apparatus for crushing which we have to consider is the Cornish rolls. This machine is too well known by all miners to require much of a description. The main features are alike in all the different constructions, although the manner of gearing and of adapting the counterweights or buffer-springs are very various. There exists a great diversity of opinions as to the advantages of large or small diameters of rolls, and broad or narrow, smooth or corrugated faces. The diameter of the rolls must depend a great deal, first, on the size of the ore to be crushed, and then on its character. Of course, the finer the original ore is, or the more laminar it is in its cleavage, the smaller may be the diameter of the crushers, though the smaller the rolls are the less gripping surface will they present, and the greater likelihood will there be of the pieces of ore remaining on the surface of the rolls without being drawn through. In order to obviate these defects, small rolls are often made with corrugated faces; but these, though correcting the one defect, have much worse ones themselves. In the first instance, the wear and tear of such rolls has been proved by many years' experience to be almost 30 per cent. more than with smooth faces. This is not only on the rolls themselves, but also on all the surrounding gearing. The second great objection to the corrugated faces is that no uniformity of size can be obtained in the ores thus crushed. The reason for this seems to be that each tooth of the corrugation pushes a portion of the ore always before it, instead of gripping it against the matrix of the other face. The sizes of rolls in use vary from 8 in. to 4 ft. diameter. The most general sizes are from 20 in. to 2 ft., with faces of from 12 to 14 in. I have, however, found it much more economical to increase the diameter and decrease the breadth of face. In my opinion the most profitable size in all respects is from 32 to 36 in. diameter, and 10 in. face. The broader the faces the sooner are they apt to wear into ridges, or crooked, and, therefore, the sooner do they require changing, besides the fact that from the moment the faces become uneven the ore can no longer be reduced to any regular size. There is a great diversity of opinion as to what the faces of rolls should be made of. Some think that nothing less than cast-steel is hard enough; others, again, that wrought-iron is the most durable and efficient; others still seem to go between, and require one roll hard and the other soft. For myself I have found that for ores of a pretty compact nature, such as blendes and pyrites, in a gangue of hard limestone, good charcoal iron, chilled, is the best material for wear. Rolls faced with this material have lasted me generally from four to six months, where cast-steel has worn crooked in from three to three-and-a-half months.

As I mentioned above, Cornish rolls in general produce about 18 per cent. more fine stuff than the jaw-crushers; but, on the other hand, the material produced by them is of a much more regular size than would be the product of the latter machine, and therein lays a great saving to the after working. Where the jaw-crusher is used as an auxiliary to the rolls, it is found that this difference of 18 per cent. is very greatly diminished, and has, in many instances, been reduced down to 10 per cent. The cost of breaking and crushing, in a good regulated mill, will not exceed 5s. 6d. per ton in Germany and Belgium. In England the average price may be reckoned at 7s. a ton, though from local circumstances this latter price is sometimes greatly enhanced. In the Eastern States of America the cost of crushing is generally from 11s. to 12s. per ton, though on Lake Superior the cost is often from 16s. to 18s., owing to the extreme hardness of the gangue, and the great fineness to which it must be crushed.

STAMPS.—The manner of crushing ores by stamps was, up to a comparatively late period, the only one known, and is still, perhaps, the method most generally in use all over the world. The large amount of work that can be got through with them, the small amount of gearing that they require, and the cheapness of their first erection, has caused most miners to overlook their many defects. Then, again, another reason for their being still so generally in use is that a miner is the most conservative of men. I do not think there is another branch of engineering where it is so difficult to introduce any innovations into the old routine. Cases of this kind are most generally found with the English miner. He has been educated practically, for instance, (say) in Cornwall, in the tin districts, where the ores, being very finely disseminated throughout the gangue, require to be perfectly pulverised before being treated in the buddles. Later on he is sent abroad to take charge of some silver-lead or zinc mine, and in nine cases out of ten the very first thing he does is to put up his battery of stamps and his buddles, as being the very best apparatus for treating his ores. The consequence is, the yield of silver diminishes very considerably, sometimes from 45 to 50 per cent. The previous owners and the inspecting engineers are accused of bad faith and false reports, and the company closes its works, whereas perhaps, all the surrounding mines are in a flourishing condition. Probably the chief reason of the failure of so many mines worked by English capital abroad is that men are employed to superintend them who do not understand the ore they are working.

Stamps, even when in all other respects they may be equal to rolls or jaw-crushers, have always the great disadvantage that they produce at least 25 per cent. more dust. Now, where the ores can be separated in grains, however fine, the production of dust or slimes is a disadvantage; first, because it thereby necessitates an extra manipulation of these slimes; and, secondly, because of the great loss of rich ore that is incurred. Of course, these objections fall away to a great extent in treating ores which are so very finely disseminated through the gangue as to necessitate a complete pulverisation prior to further treatment. Such, for instance, is the case with some of the tin ores of Cornwall, the native copper ores of Lake Superior, and gold quartz mining in general; and these are, indeed, about the only cases where it is really advisable to use stamps. The wear and tear of a battery of stamps is generally reckoned at, at least, 30 per cent. more than that of Cornish rolls of the same capacity; at least, such has always been the experience of the old system of stamps, either wooden or iron, worked by cams. How far this may be remedied by the new steam-stamps now in use in some Cornish mines, and on Lake Superior, I have not yet been able to ascertain.

Too much cannot be said against the reckless way in which the crushing of ores is carried on, especially in the case of silver-lead. I have always found, and my experience has been corroborated by that of most of the eminent metallurgists of France and Germany, that a higher percentage of silver is contained in the very fine slimes than in the coarse ore. There are two reasons for this—first, because the richest lead is most easily pulverised; and, secondly, because the silver is seldom purely chemically combined with the lead. It is generally also present either as "fallow" ore or as sulphuret in very minute crystals, which are very easily detached from the lead, and to a great extent lost. So much, indeed, is this the case that I now make a point of catching the scum which always floats on the surface of the jigs while treating rich lead ores. This scum always contains silver to a much larger extent than the ore treated. In ores containing 35 to 40 ozs. per ton this scum has often assayed 1 per cent. of silver. As a further example of the enormous loss caused by using stamps instead of rolls, I may mention that in more than 20 assays of tailings from different mills in the Colorado and Nevada mining districts I have found that the percentage of silver was from 10 to 16 per cent. higher than in the original ore. Now, of course, the larger the ore is kept the less likelihood is there of loss from this cause. Where a separation cannot be attained, except by crushing very fine, still let the miner endeavour to granulate and not pulverise his ore. This may easily be done by crushing gradually through rolls set for different sizes, and the whole mass thoroughly screened between each crushing, so that the fine stuff is not again subjected to an unnecessary pressure. Of course, in operating thus the primary cost of crushing is somewhat raised, but the eventual saving of the richer metals greatly surpasses that loss. E. G. SPILSBURY,

*New York, March* 14. Civil and Mining Engineer.

## MINING—FOREIGN AND COLONIAL.

### GOLD MINING IN NEW ZEALAND.

SIR,—May I ask your readers whether, from the following information as to the condition and prospects of mining operations in a part of our own dominions, they are not infinitely better worthy of their attention than the plausible foreign schemes hatched, for the most part, in the cute, but treacherous, brains of our Yankee cousins?

In the *New Zealand Herald* of Feb. 6 (a copy of which I send you) are particulars of the yield of gold and quartz crushed from the different mines for the preceding month of January. From this long list I select the following half-dozen mines, giving the monthly dividends per share paid during the preceding three months, and the latest quotations of values received from another, yet reliable, source:—

| Company. | Tons of quartz. | Ozs. of gold. | Average div. | Present price. |
|---|---|---|---|---|
| All Nations | 230 | 1469 | £ 0 8 4 | £ 3 15 0 |
| Caledonian | 350 | 2441 | 0 16 8 | 15 0 0 |
| Golden Crown | 392 | 1851 | 13 6 8 | 250 0 0 |
| Long Drive | 290 | 911 | 1 0 0 | 12 0 0 |
| Imperial Crown | 17 | 57 | Nil. | Nominal. |
| Hand of Friendship | 260 | 116 | Nil. | Nominal. |

It will be seen by the above that the dividends in four of these mines average about 70 per cent. per annum on the present prices of the shares, and such is the state of general depression in New Zealand that shares paying at a less rate than the above are almost unsaleable at any price. I have placed the Imperial Crown Company in the list to show the difficulty of raising capital even for the most promising venture. The rich reefs in the Caledonian and Golden Crown Mines, which adjoin the Imperial, traverse the entire ground of the latter company, which in area is three times the extent of the other two, and yet it is impossible to raise sufficient capital to carry on the necessary works for developing the mine beyond a few feet from the surface. I have also quoted the Hand of Friendship to illustrate how small a yield of gold can be made to pay actual expenses, if not more. The usual yield from this mine is 5 dwts. to the ton, 10 per cent. of which is clear profit. The attempts of the people to carry on a multitude of mining undertakings utterly beyond the financial powers of the colony, combined with other causes, have resulted in a state of pecuniary exhaustion unexampled, at least in the history of the province of Auckland, and not only mining but all other properties are terribly depreciated. For instance, in the paper I send you a report of a sale of land in one of the best districts states that 400 acres were sold for 40*l.*, and 112 acres for 12*l.*, being only about 2s. per acre.

If English investors desire to speculate their surplus cash on distant mines, it is, at any rate, desirable that they should scatter it in our own territory, and, in the present state of New Zealand, I believe they have, for once, the chance of doing so to their own great benefit.—*Malabar House, Beckenham, April* 11. WM. EARL.

## MINING IN SWEDEN.

SIR,—Referring to my letter you were kind enough to publish in the Supplement to your valuable Journal dated March 11, I beg that you will allow me to reply to Mr. Synnock's remarks in the Supplement of the following week. I should not deem it necessary to do so, but I fear that his remarks on my letter might cause some of your readers to undervalue the immense mineral resources of this country.

I observe that your correspondent refers to English and Swedish coals. Now, he may be well versed in statistics, but I must inform him that for the past four years I have been in the habit of reading the daily Swedish papers, and also the official returns of all minerals produced in the country, and I can assure your worthy correspondent that the production of Swedish coal is small indeed, amounting to a few thousand tunnas, which is about one-seventh of an English ton. At the same time, I am well aware that there are valuable coal fields in this country, but they are not developed to any extent. This information I obtained from the late Prof. Erdman's reports and geological map of the coal fields. I may say that the principal cause of

the coals not being wrought in a proper manner is that the ground has been located and taken by speculators, who, not having the means of working the coals, expect enormous sums of money from any party who may be inclined to open the coal mines.

Relative to English and Swedish coals, your correspondent says it is a well-known fact that the coals, "Swedish," can be delivered at a much cheaper rate than the former. In this I cannot concur with him, as lately the Government advertised and invited tenders for 40,000 tons of best English coal for the railways, to be delivered at Stockholm, Gothenburg, and Malmo, and, if I mistake not, the main line passes near the coal fields—at least, one branch of it does, which goes on to the latter town.

Your correspondent must certainly be aware that there are no coals in the world equal to the English and Welsh, particularly for steam purposes or gas. It does not produce so valuable iron as charcoal, on account of that the latter contains the very essential element for producing iron, that is carbon. I have been engaged in mining pursuits in various parts of the world, and, as an Englishman, I have often felt proud at seeing the black diamond in the wilds of Australia, on the slopes of the Pacific Ocean, and also at Hammerfest, near the North Cape of Norway. In this country the minerals necessary to a nation's prosperity are in abundance; but the great desideratum here is money, railways, and energy to develope the vast deposits of iron ore, copper, lead, and zinc-blende, also iron pyrites—the last-named mineral will, I believe, be largely developed in this country. Previous to the Swedish Sulphur Ore Company commencing operations here, the acid manufacturers imported sulphur from Italy, at a cost of 7*l.* per ton. I induced Messrs. Hjerta and Co. to try our ore. It succeeded far beyond their expectations, as the ore is rich, and free from arsenic; lately these gentlemen have spent about 5000*l.* in enlarging their acid works and remodelling the furnaces for burning iron pyrites. These gentlemen have two acid establishments—one at Stockholm and another in Gothenburgh. The demand for acid is continually increasing, as is shown by the acid imported from Belgium and Denmark. I believe your correspondent has visited these mines, also other sulphur mines in Sweden, and I can assure him that I shall be pleased, and I hope edified, by reading his promised contributions on the mineral wealth of this country through the columns of your valuable Journal. WM. HOSKIN.

*Suphur Mines, Norrtelje, Sweden.*

## AN IMPORTANT STANNARIES AND MINING QUESTION.

TO THE EDITOR OF THE WEST BRITON.

SIR,—In a recent judgment of the learned Vice-Warden of the Stannaries, in the case of the Prosper United Mining Company (Palmer's case), which has excited some attention in the mining community, I notice that the laws of the Stannaries, 26th Geo. II., No. 11, "For the better recovering of costs," and Pryce's "Mineralogia Cornubiensis," b. 2, cap. 4, p. 173, are mentioned in reference to the view, that in cost-book mines the accounts must be approved by a majority in value of the adventurers; that is, a majority of the whole number of the shares in which the mine is worked and carried on. I am aware that this view has been generally held by the officials and practitioners in the Stannaries Court, and it has occasioned great inconvenience in carrying on cost-book companies; so much so, indeed, that I believe it was one of the principal causes why the Stannaries Act, 1869, was promoted and obtained, by which Act this supposed state of the law was altered. I say supposed, because beyond this article of the Stannaries laws, 26 Geo. II., No. 11, I am not aware of any distinct authority for such an incident to a cost-book company. When looked at carefully, I cannot think that this oft-cited regulation, No. 11, is an authority for the general proposition that the majority of shareholders present at a meeting duly convened cannot bind the whole body unless there is a majority of all the shares present, in person or by proxy. It is a regulation "for the better recovery of costs," and after a long preamble, and referring to the case of deceased partners, it prescribed certain formalities to be observed, one of which is a delay of three months after an account of the costs has been made up by the pursers or clerk, and approved of and signed by the major part of the adventurers, and delivery of a copy to the defaulting adventurer, and it then declares what proceedings may be taken. This, I venture to submit, has nothing to do with proceedings at a duly convened meeting of adventurers; indeed, everything required may be done without having a meeting of adventurers at all. It gives an additional remedy, but in no respect limits or curtails the powers of the adventurers in a meeting duly convened.

These laws were passed at the Convocation held August 25, 1752 (26 Geo. II.) Pryce's "Mineralogia Cornubiensis" was published in 1778, and on looking at what he says, I venture to submit that it is an authority contrary to the practice which was followed in the Stannaries Court, as above mentioned, and chiefly rendered necessary the Stannaries Act, 1869.

Pryce says (B. 3, cap. 4, p. 173):—"The principal manager in the mine is the puser or book-keeper, who keeps all the accounts, and receives and pays all the money. This person is usually one of the adventurers, and is chosen by the rest for the administration of their affairs during the intervals of their monthly meetings, at each of which a statement of the transactions and accounts of the mine is produced, and after it is regularly examined and passed the total charge is divided according to the doles or shares, of which each adventurer is obliged to pay his respective quota. The adventurers present at these monthly meeting take into consideration the most effectual methods of working the mine, and their determinations, which are settled not by voices but shares, are conclusive for the whole body."

It will be seen he states distinctly that the determination *of the adventurers present* at the periodical account meetings of the mine, voting according to the number of their shares, *are conclusive for the whole body*. It is difficult to conceive anything clearer than this, and it must be remembered that Pryce wrote in 1788, or 26 years after the Convocation Laws of 26 Geo. II. He refers in his work to Pearce's Statuary Laws, and was no doubt well acquainted with them.

It may be rather late now to raise this question, but it still has an important bearing on many others which arise in the winding-up and other proceedings in the Stannaries Court. I trust, therefore, I may be pardoned for stating my doubts and calling attention to these authorities. I am not aware that there has been any *considered judgment* on the subject, and therefore hope there is no impropriety in asking you to insert this letter from— A CORNISHMAN.

## NORTH TREBURGET—LATE TREGARDOCK.

SIR,—In reference to Mr. Albert Smith's statements respecting this mine, published in the Supplement to the Journal of March 4, I can corroborate his statements as to the very promising appearance of the lode he refers to; this splendid looking lode has been unnoticed by former companies until the last 15 months, at which time a few gentlemen of Leeds and one or two of Cornwall agreed to work the property, and as nothing was done on the lode referred to by your correspondent, we were entirely guided by the report of Capt. John Goldsworthy, the late manager, whose sole report was confined to the merits of the lode in the old mine, which is, as Mr. Smith states, 40 or 50 fms. north of the lode, on which a shaft is sunk 30 fms. under the level of the beach, from which a great deal of lead has been extracted, sent to market, and sold for 20*l.* per ton, it being pretty rich for silver. An adit has been driven upwards of 200 fms., from which also a great deal of lead has been sent to market. Nothing has been done on the old lode that this shaft has been sunk on, but the long adit cleared and secured, therefore the present agent knows nothing of the position of the old workings. No doubt Capt. Goldsworthy's report will shortly appear in your most valuable columns. The agent, who Mr. Smith states to have passed the zenith of his day, and had lost his dial, is still a very active man, and has had the management of mines for more than 20 years, with agents under him nearly all that period, and is still the agent on the mine. It was him, and only him, that brought this lode to the notice of the present shareholders; he discovered it on the beach at a low tide, and made a blast or two in it, from which it turns out some splendid stones of solid lead: those samples being sent to Leeds, with a statement where they were broken from, induced some of the shareholders from Leeds to visit the mine, with some of the shareholders of Callington, and whilst on the spot the agent pointed out the part of the lode on the beach it was broken from, and they ordered more blasts to be made in another part of the lode, at which point it was considered to be worth from 50*l.* to 55*l.* per fm. as far as could be seen, but being on the beach of course it could not be followed. Since then the lode has been traced on the beach, several blasts made, and fine rocks of lead have been broken. The agent was then instructed to drive on the course of this lode at high water-mark, as well as to put down a trial shaft on the course of the lode a fathom or two in from the adits mouth so as to prove the continuance of the lode going down under the sea level. The shaft has been sunk nearly 10 fms., the lode found regular and well-defined, producing saving work for lead, and the last 6 ft. sinking the lode, as well as the nature of the rock, is much improved, and it has been proposed that another 10 fms. should be sunk before the level is extended out under those bunches of lead before mentioned on the beach, as also to extend out a level eastward; this will leave 16 fms. of backs for stoping, as well as 4 fms. of arch underneath the beach, so as to prevent the water breaking in.

Having said so much on this point, I must now beg to ask Mr. Albert Smith a few questions. The first is, can he prove that the agent by driving his level on the course of the lode has a hole to the sea? second, what part of the level has he holed? third, is the level driving towards the sea? fourth, can he tell the right bearing of the lode? fifth, can he prove any nearer point than the south channel, somewhere about Torquay, in Devonshire, that we should hole to the sea? sixth, will he tell me whether the level is driving towards the sea or from the sea? I make those remarks for this reason—I do not believe there ever was a man such as Albert Smith that ever visited the mine; if so, I can only tell him he made one of the most erroneous statements that ever man could utter. I am sure if he has visited the mine he could see before him a level surface of water that ought to teach him that truth is like the water, it will take its level. If there is such a man as Albert Smith he should again visit the mine, in order to save his reputation, and to prove he is correct in his statements. The agent would be most happy to meet him any time he would appoint. For my own part I know no nearer point to hole to the sea, according to the longitude of bearing to the lode, than somewhere about Torquay, on the south channel. I may here remark that the mine has been inspected by several mine agents who have had long experience in lead mines, and they all report it to be one of the best speculations in Cornwall. I believe, as a rule, the mines which have been abandoned once or twice in this county are the safest investments, and from my own experience there are no mines in Cornwall that are now paying dividends but what have been abandoned once or twice. I believe it is the intention of the present company to dispose of more shares, so as to raise additional capital to work the mine in a more spirited manner. At present there are but a few shareholders connected, and I would advise those who may be inclined to purchase shares to visit the mine, and see for themselves, or send their agents to look at the property, when they would see a lode in the present end from 2 to 3 ft. wide, saving work, but at the same time they would not be able to corroborate Mr. Smith's statements. True, that in driving the level it holed to the sea; indeed, the level, as I have already stated, is in an opposite direction. They would also see a pile of lead work on the floors, the produce of the drivage. By extending this level on the course of the lode the agent states it will form a junction. By driving 26 fms. further, with a lode called No. 3, he states those lodes can be seen at surface, where they form a junction in one lode, 12 ft. wide, and can be traced no further east; but, combined as one lode, it is the opinion of the agent, as well as those who inspected the mine, that we may expect good results at the junction, at a deeper point to which the present end is approaching.

I should feel obliged if Mr. Smith would state what part of the mine the present company has cross-cut to a lode. There are no such charges on the cost-sheets. The level is driven on the course of the lode, and no cross-cut ever driven by the present company, neither has there been anything noticed as regards working on the lode, which Mr. Smith so admires, except by the present agent.

A SHAREHOLDER.

## SHELTON CLAY AND TIN MINING COMPANY.

SIR,—Allow me through the medium of the Journal to direct the attention of the shareholders to the very encouraging report and statement of accounts just issued by the directors. Three years have not yet passed since the formation of the company. The subscribed capital is only 5969*l.* 10*s.*, out of which amount 2407*l.* 17*s.* was expended in the purchase of the sett, plant, machinery, leases, &c., leaving the small sum of 3561*l.* for the development of the mine, and the working of the tin lodes and clay-beds. By the skilful and judicious application of this sum the mine has returned tin to the large amount of 8612*l.*, in addition to 368*l.* estimated value of clay, which, however, has been only partially realised. Though the services of the directors have been gratuitously given, no personal interest could be more rigidly supervised, while the unwearied and laborious exertions of some, in particular, of those gentlemen for the common good is most creditable to them and assuring to their fellow-shareholders. The advantage of additional capital at the present juncture will be to give a greater ratio of profits according to the amount invested by means of increased facilities for the working of the lodes and the proper development of the property than can be otherwise obtained. A DUBLIN SHAREHOLDER.

## MINING IN CARDIGANSHIRE—No. I.

SIR,—Under this heading many a communication has been made to you, and has appeared in your valuable Journal, which is always open to those who would advocate legitimate mining at home and abroad. But still there is room, as appears to me, for further remark on the mineral wealth of this famous county—famous not only for successful mining, but for mining failures also. But while many of the failures have been due to poverty of the particular locality, it has, I think, far oftener been owing to mismanagement, and not the least cause has been the unwarrantable and almost baseless estimates of large results at too early a period—before the mines have been anything like opened out and made capable of yielding such results, if they possessed the elements. Many a good property has been sacrificed owing to the high expectations raised by untruthful and designing men, quite unwarranted by the prospects of the mine, or in the time and for the outlay indicated.

Such disastrous consequences have lately befallen a most respectable company mining near Talybont by their agent's reports and estimates of returns in a given time. The immense reserves of ore said to be in the mine, waiting the erection of reducing machinery only, cannot now be found, and the large returns to be made by March 1 are not to be found either; 60 divided by three leaves 20; this is the result of working out of the problem submitted. [See Journal late in February.] However, this is not the only case, for who does not recollect the results of working East Bronfloyd? And it surely will not be the last act of the kind, as those who live to see the dressing of the ore at another mine near Talybont will discover, and many, I fear, to their cost. If the 1600*l.* worth spoken of as being at the mouth of the adit turns out after the steam-crusher is erected to be 60*l.* worth only, it will surprise nobody here. These remarks do not in any way condemn the mines, but the system pursued, which too frequently tends to turn the public mind altogether from investment in mining.

I will say no more now, but with your permission will next week endeavour to present your readers with a brighter side to the picture, and direct them as best I can where they will find a fair chance of a return for their investments; and if failure issue it will be due to the poverty of the mine, and not the knavery of the men.—*Aberystwith, April* 5. OBSERVER.

## IMPERIAL OTTOMAN MINING COMPANY.

SIR,—I should be glad if you would allow this letter to appear in your columns. It is the only way I have of making known my views to my fellow-shareholders, but as I have watched the Imperial Ottoman Mine since its commencement, and as things there are not progressing as a practical miner I should like to see them do, I think there ought to be a general meeting to discuss matters, and I hope this letter may be the means of inducing the shareholders to take some interest in their property, but there is decidedly something wrong, and a general meeting will show whether it lies with the directors, secretary, contractor, or captain. By all means let us have an early meeting; there ought to have been one in December last—why there was not remains to be explained. Some very unpleasant reports are about, which, if not true, should be repudiated at once, as surely the shareholders have a right to benefit by the mine, and the rigging too, but in this case (if reports are true) it appears to me that, under the pretence of differences, they are going on the Scotch system of scratching one another's backs. Hence the necessity of the shareholders looking to their own interests, and, if necessary, changing the directory. All reports ought to be inserted in the *Mining Journal*—in all good and properly-conducted mines this is so.

*London, April* 10. MINER.

## IMPERIAL OTTOMAN MINING COMPANY.

SIR,—I should feel obliged if you would allow this letter to appear in the Journal, as I know very few of my fellow-shareholders in the Imperial Ottoman Mining Company; but from the secrecy in which the affairs of the company are conducted, there never being any reports in the Journal, and no meeting since last June, I think that attention should be drawn to these facts, and that a meeting ought to be convened as soon as possible.

*New Cross, April* 11. A LARGE SHAREHOLDER.

## IMPERIAL OTTOMAN MINING COMPANY.

SIR,—I shall feel obliged by your allowing me to call the attention of the Chairman and directors of the Imperial Ottoman Mining Company (Limited) to the necessity of a meeting being convened as soon as possible, so that the shareholders may be made acquainted with the proceedings that have taken place at the mine since the last meeting—nearly 12 months ago. The reports received are so vague and ambiguous that I am quite at a loss to understand how matters are, and I feel assured that must be the prevailing feeling amongst the numerous shareholders.—*City, April* 13. A SHAREHOLDER.

[For remainder of Original Correspondence see to-day's Journal.]

# Meetings of Mining Companies.

## NEW CENTRAL SNAILBEACH MINING COMPANY.

The third half-yearly meeting of the shareholders was held at the London Tavern on March 31,—Mr. JOB TAYLOR, J. P., in the chair.

The accounts showed a credit balance of 2639*l.* 12*s.* The following reports of the directors and agent were submitted:—

The directors present a statement of the company's affairs, made up to the 15th March, 1871 (duty audited), and by which an available balance of 2639*l.* 12*s.*, beyond liabilities is shown to the credits of the undertaking. Since the last half-yearly meeting the directors have completed the arrangements made with the lessors referred to in their last report, and they used every exertion to complete the new plant on the mine, at Hogston Hall, but in consequence of the severe frost of the past winter, which for many weeks rendered it impossible to carry on any building operations, they have not yet been able to bring it into working order. The erections are now proceeding rapidly, and your directors are assured that they will be completed and the machinery at work before the end of next month. In regard to mining operations, your directors have pressed forward the works to their fullest extent, and have great satisfaction in referring the shareholders to Capt. J. Kitto's report on the condition and prospects of the company's mines. Every exertion will be made to develope the property, and secure the early payment of a dividend. Since the last meeting, Mr. Thos. Thompson has resigned his office of secretary, and the directors have appointed Mr. J. S. Wainwright, of Dudley, to succeed him. From this time the registered office of the company will be at No. 3, Birmingham-road, Dudley, the office of Mr. Thompson, No. 5, Whitehall, London, being still available for the purpose of reference and enquiry as heretofore. Mr. E. H. Lowe retires by rotation from the office of directors at this meeting, and declines to offer himself for re-election. Mr. Henry Rotton, of Moseley Common, near Birmingham, for many years the manager of the National and Provincial Bank, in Birmingham, but now retired from business, offers himself as a candidate for the directorate. Mr. Bell, the auditor of the company, also retires at this meeting, and offers himself for re-election.—J. TAYLOR, H. M. WAINWRIGHT, R. HILHOUSE.

Since the shareholders' meeting, held in August last, we have extended the 200 yard level but little, as our main object has been directed towards the deeper development of the mine, in order that we may as soon as possible get out of the influence of the shale, and with this view we have sunk a sump 30 yards below the 200 yard level, where we are again driving out for the purpose of proving the character and composition of the lode. I may, however, remark that in the 200 west end the lode is still strong and kindly, notwithstanding the ground on the north side is of a soft and shaley character, and my opinion is that the driving of this as a pioneer level is well worth considering, as in the Old Snailbeach Mine, adjoining us, the shale has been found much deeper in some places than in others, and we may reasonably expect the same result in our sett. I would also advise the same (200 yard) level being driven east towards the old Snailbeach Mine, as no level has been driven in that direction below the 124. In the 230 yard level we have lately had some nice stones of ore from the part of the lode we are carrying in the driving, but most of the lode in this level is still standing to the south. Our object has been to push on the driving of this level as rapidly as possible, in order to secure better ventilation, by effecting a communication with No. 2 sump, which we are sinking below the 200 yard level, but immediately this is accomplished we shall cross-cut the lode, in order to prove its size and character. I may add that, so far as we have gone, the country rock to the north of the lode has been much more firm and flaggy than in the levels below; this level is now extended west from No. 1 sump about 33½ fms. No. 2 sump is now down 8 fms. below the 200 yard level; the lode appears to be very large, and contains a quantity of the most beautiful carbonate of lime, with nice strings of ore, and is improving as it goes down, but we have not yet been able to prove its size; this is also being pushed on in the easiest ground we can find for the same object as mentioned above—to secure ventilation in the level below.—Hill Sett: The engine-shaft in Mytton Dingle has been sunk altogether about 44 yards, and is now down 30 yards below the adit level, where we have driven a cross-cut, and intersected the lode at a distance of 8 fms. on the course of the lode, which, although so far poor for lead, is one of the kindliest I have ever seen, and I have not the slightest doubt that it will ere long prove very productive; in the present end it is from 4 to 5 ft. wide, and daily improving in both size and character. I may also add that the water which some time since was so very strong in the sumps below the shallow adit level, and which we had to suspend in consequence, has all been drained dry, notwithstanding its great distance from the deep level, being about 160 yards apart, and the sinking has been again resumed; here the lode is at least 6 ft. wide, and yielding some very good ore. The draining of the water for such a great distance is an excellent feature, and shows that the lode for the whole way is both strong and porous. We have placed a portable engine on the top of the new shaft for pumping the water and drawing the stuff from this part of the mine. The masons and engineers are getting ahead fast now with the erections at the old mine, and would have had the whole complete two months since but for the long continuance of bad weather, which prevented the possibility of proceeding with the buildings, but they now state that the whole shall be finished by the end of April, and I see no reason whatever to doubt it.—JOHN KITTO.

The CHAIRMAN, in moving the adoption of the report, stated that they would all be sorry that the machinery had not been sooner completed, but everyone was aware that the long and intensely severe winter had interfered with all surface operations, and they could not complain more than their neighbours. Everything, however, was being got on with as quickly as possible.

Capt. KITTO explained that they were driving in the softest and poorest part of the lode in the old mine in order to form a junction with the sump sinking below the 200 yard level, and thereby effect a good ventilation, the air being at the present moment very bad. For the same reason the sump itself was being sunk in the softest part of the lode. In Mytton Dingle, where they had cross-cut the lode it was not possible to have anything more promising. The cross-cut was 80 fms. to the west of the sump sinking through the ore ground, which it completely drained, thus showing the porous nature of the ground throughout—a very good sign. The level from this cross-cut would be 25 fms. below the bottom of the sump, and give that quantity of backs. The two stones of ore now on the table, and which he had himself broken the day previously from the bottom of the sump, would show the value of the lode there.

The resolution adopting the reports and accounts was then passed.

Mr. H. M. WAINWRIGHT said that Mr. E. H. Lowe having retired from the direction, due notice had been given, and he begged to propose in his place the name of Mr. Henry Rotton, of Moseley Common, Birmingham, as a director for the ensuing year. Mr. Rotton had been the manager of the National and Provincial Bank in Birmingham for a period of no less than 30 years, but he was now retired, and having plenty of leisure time, and being well qualified from his past experience for such a post, would be a valuable addition to the board. He (Mr. Wainwright) had given a large amount of his time to the affairs of this company, and he might tell the shareholders that whilst their new plant would be one of the cheapest it would be at the same time, for its size, one of the most efficient in the county of Shropshire.—Carried unanimously.

Mr. J. T. Bell was then elected auditor for the ensuing year.

Mr. H. M. WAINWRIGHT said it would not be right for that meeting to separate without rendering a cordial vote of thanks to their late secretary for the very valuable services he had rendered the company during his connection with it, and he trusted the meeting would be as unanimous on this point as were the directors. Now that three of the directors reside in the neighbourhood of Dudley the majority of their meetings would be held there or at the mine, and as it would be impossible, as they were aware, for Mr. Thompson to attend these meetings, it was felt that some change was necessary. At the same time he felt quite sure that Mr. Thompson would lose no opportunity of forwarding the interests of the company wherever it was possible, and he might state that the office at Whitehall would continue as a London office of reference, where every information connected with the company could be obtained.

Mr. R. HILHOUSE, in seconding the resolution, spoke in the highest terms of the manner in which he had always found the company's affairs conducted. That he on no occasion met with Mr. Thompson without receiving from him every possible information.—Carried unanimously.

Mr. CHARLES HILHOUSE had much pleasure in proposing a vote of thanks to the Chairman and directors for their services to the company. He was quite sure they had the interest of the shareholders well at heart, and would, if possible, bring the ship into port. He would not sit down without saying how heartily he agreed with the cordial expression of the good feeling of directors and shareholders towards their late secretary.

Mr. THOMPSON said he felt deeply grateful to the shareholders present for the manner in which they had received Mr. Wainwright's resolution. He had long felt that he held an anomalous position in the company. It was absolutely necessary that the majority of the directors' meetings should be held in the country, and, as the shareholders are aware, from the terrible infirmity under which he was suffering it would be impossible for him to attend them. He felt this was not right, and the company's interest must necessarily suffer. He felt great regret at severing his official connection with them at a time when prosperity would appear to be about to crown their efforts, but they might rest assured that so strong were the ties which bound him to its interests that he would continue to do his utmost to promote the future welfare of the company.

Mr. JOB TAYLOR made a suitable reply on behalf of himself and co-directors, and the proceedings then terminated.

## PEN'ALLT SILVER-LEAD MINING COMPANY.

An ordinary general meeting of shareholders was held at the Guildhall Coffee House, on Tuesday,—Mr. DIXON in the chair.

Mr. THOMAS (Tilly and Thomas) read the notice convening the meeting. The report of the directors was read, as follows:—

The directors, in their last report, expressed a confident hope that they should be able to announce to the present meeting that large sales of ore had been made, and the proceeds received. This hope has not been realised, and in consequence the shareholders will have to take into consideration the most prudent way of carrying on operations, in order that the capital already expended may not be dissipated. From the character of the ore it was considered that it could be best treated by the patent German dressing machinery; this was erected, and put to work. A series of delays occurred through various alterations being required, but at last Capt. Glanville reported that it was working satisfactorily. A severe frost then interrupted the operations at this mine, as well as all other mines in the country, but soon afterwards Capt. Glanville further reported that the machinery was working night and day, and that he was doing his best to have 50 tons of dressed ore ready for market by the end of January. Similar assurances had been repeatedly given by Capt. Glanville before this period to each of the directors verbally, as well as in writing. It will be remembered that in their last report the directors stated that sufficient ore had been brought to surface to pay for all the plant and machinery; this statement was made on the distinct authority of Capt. Glanville, who endorsed it at the meeting held at the mine in November last, at which he was present. It had been previously read over to him no fewer than three times, and on each occasion he distinctly confirmed it, but it was not officially adopted until Capt. Glanville had personally conducted the director by whom it was written over every part of the mine, shown him the several heaps, and declared repeatedly that they were as good as money to the shareholders. About the end of February Capt. Glanville reported that he had 28 tons of dressed ore in the dressing-house. The directors had already expressed their dissatisfaction to Capt. Glanville at the slow progress he was making, but unable to extract from him any explanation, and finding otherwise that he was not paying that degree of attention to the interest of the mine which was expected, the directors requested Prof. Forbes to inspect the mine and machinery. That gentleman reported that instead of 28 tons of dressed ore being in the house, there were not more than between 7 and 8 tons, and this imperfectly dressed. Capt. Kitto, who was afterwards called in, made the quantity still less. Mr. Forbes' report was generally unfavourable, but he advised the completion of the connection between Nos. 3 and 4, and the driving of the lode in No. 4, so as to get under the outcrop of gossan at No. 2. Capt. Kitto recommended the same, the latter expressing his conviction that the mine would yet prove a very profitable one. The directors had intended, as soon as the workings in No. 4 had been brought into profitable operation, to drive a deep cross-cut further east, near the base of the mountain, in order to intersect all the lodes at that favourable point; but the unfortunate issue so far will suspend the prosecution of that work.

A meeting of some of the principal shareholders was privately called a few days ago to consult on the course to be taken in the present emergency. Mr. Bond, a large shareholder, and Mr. Dixon, a director, were requested to visit the mine in order to ascertain the causes of the small proceeds of lead from the dressing of the large quantities of ore brought to surface. These gentlemen were unable to obtain any useful information from Capt. Glanville, who seems to have taken no care of the mine whatever, but they found from their own examination that very large quantities of the finer qualities of lead and silver had from simple negligence been allowed to pass from the dressing-house into the river, where they had formed deposits perfectly visible to the eye.

The shareholders will perceive from the balance-sheet that in order to carry on the mine, which the directors strongly recommend, it would be necessary to raise a further amount of capital without delay. There are 7000 shares yet unissued. The company has also certain claims upon individuals, which have been placed in process of adjustment; it would not be expedient to refer to them more fully, but if the shareholders themselves would take up a portion of the unissued shares in preferential or some other way sufficient to continue the workings in Nos. 3 and 4, the difficulties of the mine would be practically surmounted. The directors have good reasons for believing that these workings will pay well, and also those for effecting the proposed deep cross-cut at the base of the mountain. In this way the mine would soon obtain a good position, and no long time elapse before it became a remunerative property. The present directors are prepared to place their resignation in the hands of the shareholders.

The CHAIRMAN, having explained the different points of operation by means of a plan, stated that, so far, the deeper the explorations the richer became the lode, and there was no doubt that as soon as they were in funds it would be wise to drive a deeper cross-cut east, so as to strike the lode at a greater depth. At the last meeting they had hoped and believed that by this time they would have been in a position to declare a dividend, but circumstances had prevented them doing so. Several eminent mining authorities had inspected the mine at different times, and it had been observed that each inspection was followed by a purchase of shares by those whom it was believed were associated with the inspectors. Therefore, the directors had the strongest grounds for believing that the mine was everything that could be desired; and, that being the case, the first object of the directors was to provide the machinery necessary to bring the produce into a marketable condition. At the last meeting some remarks were made condemning the delay which had taken place in the erection of the dressing machinery, but notwithstanding that the directors did not come to any hasty conclusion as to the class of machinery to be adopted; and so far as reason and the evidence of fact could guide them, he believed the machinery would be found tolerably satisfactory for their purpose. Some of the directors conversant with mining matters visited the mines at which similar machinery was in successful operation. He did not form one of the party, because he was generally content to leave all mining matters, with which he did not profess to be *au fait*, to be settled by others. Capt. Glanville accompanied those of the directors who inspected the machinery, and every confidence was expressed in it, seeing that it was in profitable working at a mine yielding ore of much inferior quality to that at Penn'Allt. Accordingly, contracts were made for the erection of similar machinery; but, as was usual under such circumstances, it was not completed in the stipulated

time, for instead of July it was not in full work until November, when the directors visited the mine. At that time there was a very large quantity of lead ore on the surface, sufficient, it was generally supposed, to pay for the whole cost of the machinery. The directors certainly expected that as soon as dressing operations were commenced they would have a very considerable quantity of lead—say, 100 or 200 tons—ready for market. But at the end of December Capt. Glanville informed them that he was sorry that he had only got 50 tons, which he looked to have ready for the market by the end of January. The end of January came, but the 50 tons were not ready—on the contrary, the amount began to diminish, till it reached 28 tons. The end of February came, but the money to be realised by the sale of lead which the directors calculated would be amply sufficient for all their purposes, gradually dwindled down; while the reserve of unissued shares, which the directors had always looked to in any case of emergency, could not be disposed of except at a ridiculously small price, the market having been disquieted by reason of the delays in sending ore to market, and also by the fact of Capt. Glanville having disposed of his shares. Capt. J. Kitto and Prof. Forbes consider the mine has not been developed, and that the lode will improve in depth in quality and quantity. As to the extraordinary way in which the lead ore had disappeared from the surface, he really did not know what to say. It was there, for the directors saw it with their own eyes—hundreds, if not thousands, of tons. Of course, it was impossible to say what percentage of lead it contained; his firm conviction was that in those heaps there could not have been less than 100 to 150 tons of lead, but at last they found they had only about 7 tons on the dressing-floors, and three-fourths of that was so badly dressed that the smelters offered them only 8*l*. per ton. That brought them to the dilemma in which they now found themselves. They had called together some of the principal shareholders, who delegated Mr. Bond and himself (the Chairman) to visit the mine. Mr. Bond had had a large mining experience in different parts of the world, and the result of their investigation was that, making due allowance for every delay, and although Nos. 1 and 2 workings did not show much indication of lead now, the ends being excessively charged with barytes difficult to extract, there was still a grave question to be discussed. As Capt. Kitto and Prof. Forbes recommended the discontinuance of operations at Nos. 1 and 2, the directors had no hesitation in deciding that no more money should be expended in them. No. 3 was simply being driven for the purpose of enabling them to sink the shaft to intersect the good bunches of lead that had already been met with; and in No. 4, where a very large cavern had been excavated out of the vein, there were several diagonal strings of lead, if he might so term them, which no doubt crossed the shaft, now about a fathom of being through. As soon as the shaft was through there would be at once a considerable amount of lead ground ready for stoping. He was perfectly satisfied the mine would pay, and pay well for working. Upon examining the rollers it was evident that a large quantity of stuff had been passed through them, and that the produce must be somewhere. Mr. Bond and himself took about 8 lbs. of the refuse from a point some distance down the river—an impalpable powder—and "vanned" it down to about 2½ lbs., which upon assay yielded 35 per cent. of lead and 24 ozs. 3 dwts. of silver to the ton. Another sample taken at a still greater distance from the floors yielded 21 per cent. of lead and 17 ozs. 16 dwts. of silver per ton. They then took a sample from the Cornish buddle erected by Capt. Glanville, and that gave 25 per cent. of lead and 16 ozs. of silver—it was the least valuable of all the three. In the crushed stone, of which there was a very large heap, there was no trace at all. They could not account for the disappearance of the large quantity of lead contained in the ore which was on the mine in November and December. The coarse lead must be somewhere. The rollers did not crush all to an impalpable powder, and if the jiggers did not work satisfactorily the lead they have would pass away, and be deposited in the drain or river, but there was no coarse lead to be found anywhere. Where it had gone was a question he could not answer. The machinery, no doubt, required alteration—the percussion-table was a sort of patent which he must confess he did not think much of, and the patent buddle also required some modification. The immediate question, however, for the meeting to consider was as to the future—they required more money if the mine was to be worked, and he, for one, should certainly be very sorry to see it given up, because he believed it was really a good mine; and he did hope they would all pull together, and bring it into a prosperous condition. Mr. Sopwith, jun., in whose opinion he (the Chairman) had the greatest confidence, had no doubt about the value of the mine, and he (the Chairman) was perfectly satisfied that with a total change of management they could make their ores pay their expenses, and considerably more. If the machinery would not do its work there was the old remedy of hand-washing, which although a little more expensive was very efficient, but he hoped they would be able somehow or other to get over their difficulties, and raise further capital. He then moved that the report and balance-sheet be received and adopted, which was duly seconded.

Mr. BOND recapitulated what the Chairman had stated in regard to the testing and value of the lead and silver in the refuse as found in the river, adding that there could be no doubt that tons of rich lead ore had passed through the machinery, and washed down the river to a distance of about a mile from the dressing-house. As to the future, he should recommend that operations be confined to No. 4 working east and the rise, in order to communicate that working with No. 3. By adopting this course the expenses would be far more than met by the returns. He directed attention to the importance of driving a deeper level east under the No. 4 working, at about 50 fms. deeper. That would test the lode at that increased depth, and at the same time drain the No. 4 working. As to the ore, there was no doubt the finer portions had passed into the creek, but there was no doubt the coarse-grained portions had been surreptitiously disposed of.

Capt. GLANVILLE said that he was taken very ill, and had to lay by for five weeks, and had to leave the men in charge of the dressing-house. When it was found the ore was going to the river a drain was made to catch it, for it was impossible to catch it by such machinery. The chief portions went into the slimes, and all the silver into the river, and ever would by that machinery. He would not advise anybody to touch such machinery again; and, as to the coarse lead, he could not tell where it had gone to.

After a lengthened discussion, the report and accounts were received and adopted, and a resolution was passed instructing the directors to take legal proceedings against those who are indebted on account of shares to the company.

It was also resolved, upon the proposition of the CHAIRMAN, seconded by Mr. JONES, that the meeting empowers the directors to issue the unallotted (7000) shares.

Messrs. Dixon, Bond, Craig, Jones, and Westmoreland were elected directors. A vote of thanks to the Chairman terminated the proceedings.

## THE LOVELL MINING COMPANY.

The usual quarterly meeting of shareholders was held, on Thursday, at the offices in Bucklersbury,—Mr. WM. CARPENTER in the chair.

The SECRETARY (Mr. A. Lawrence) having read the notice convening the meeting, and the statement of accounts, which showed a balance of 54*l*. 7s. 9d. against the company, the following reports from Capts. J. Nancarrow, J. Rowe, and Thos. Parkyn were read:—

*April* 12.—Since the commencement of operations in February, 1870, we have cleared the south adit throughout its whole extent, cleared and secured two shafts down to that level, fixed a footway in one of them, and prepared both for drawing. Two lodes have been laid open by these clearings, each running east and west; the south one (as previously reported) strikingly resembles in its general character and composition the south lode at East Lovell, contains tin, and promises to well repay development. The north lode, which is known as the great lode, has a strong masterly appearance, and the north shaft is sunk in it to the adit level, but there is very little of the lode worked so deep as that level, and nearly all the ground there and all below is standing whole. We have stoped down a piece of lode, east of the shaft, 4 fathoms high, where it is about 4 ft. wide, has yielded good tinstuff, is greatly improved, and we find it from recent assays and stamping to be worth full 20*l*. per fathom; here the lode is composed chiefly of chlorite and mundic, with which the tin is mixed. There is a level driven west, 7 fms. above the adit; its whole extent is about 8 fms., and the last 3 to 4 fms. driven the lode is from 6 to 8 ft. wide, the whole of which is tinstuff that can be worked to profit; this part is entirely free from mundic. We shall have to stope down ground near the shaft, or drive under it, in order that this may be worked to the best advantage. There is an old shaft still west of this, which is cleared down to water, and we have found good stones of tin in the stuff, which bespeaks the productive character of the lode. This shaft will have to be communicated with the level driven west from the north shaft, when a great quantity of valuable tin ground will be opened up above that level, and the driving of the adit west will open it up below. As the hill rises westward the adit will be deeper in that direction, and there is no calculating the quantity of tinstuff that may there be opened up. The stamps, consisting of a water-wheel, 30 ft. diameter, 3-ft. breast, with iron-axles and 16 heads, is completed, and works admirably. The pass, strips, and first set of slime pits are finished, the round buddles are in course of construction, and one nearly ready to work, so that from next week the stamps will work regularly. This would have been the case much earlier, but having to blast hard granite for 40 fms. in length, and sometimes 15 ft. deep, to drain the water off from the wheel, and to blast for more than 50 fms. in length, to bring the water to the wheel, besides the excavation for the wheel itself, which was deepest of all, and very hard for breaking, together with hindrances by the inclement weather, defied all our calculations, and prolonged the work far beyond what could have been expected. The heaviest work and expense, however, is now over, but there is yet more to be done in the dressing-floors and calcining ovens to be built, which will cost about 200*l*., and take three months to accomplish, after which, with the kind of stuff now being broken, we can work to good profit. A railway, also, should be constructed to take the stuff from the shaft to the stamps, which might cost 100*l*., but this may be deferred a little. An important advantage in the working of this tin ground is, that no steam-power is required either for stamping or pumping, so that the working will be very inexpensive. I have much pleasure in congratulating the shareholders on the prospects of this undertaking, and trust the development of the other lodes will greatly add to its value.—JOHN NANCARROW.

*April* 3.—I have inspected the Lovell Mine to-day, and beg to send this as my report of it:—The Lovell is situated in the parish of Wendron, in the county of Cornwall, a district which has been long celebrated for its rich tin mines. The Old Wheal Lovell, which lies about ¼ mile to the west, was a very rich mine for many years. The Trevenen and Tremenheere Mines were rich for 200 fms. deep. In the present day Trumpet Consols is highly profitable, paying good dividends to the shareholders. Then there is the celebrated East Lovell Mine, which is about ½ mile north-east of the Lovell Mine. This mine is very rich indeed; the lode in some places is worth from 200*l*. to 400*l*. per fathom. This speaks much in favour of the district in which the Lovell Mine is situated. The Lovell sett is about 400 fms. square, and is traversed by several lodes: one of these lodes, towards the south part of the sett, is now being wrought on. This lode is drained of water about 18 fms. below surface, by an adit which the present party have cleared and secured for about 180 fms. in length. The old men must have had considerable quantities of tin from this lode, to judge by extensive workings on it. A shaft is opened from the surface and sunk about 18 fms., or to the adit. There is one pare of men breaking the lode to the east of the shaft, taking up their stopes from the bottom of the adit. The lode at this place is 4 ft. wide, worth 20*l*. per fathom for tin. The lode will cost about 10*l*. per fathom to drive an end through it, and after it is opened it can be stoped for 5*l*. per fm. About 8 fms. up from the adit they have cleared out some old workings; the lode here is from 6 to 7 ft. wide, much softer for breaking and stamping. The produce is not so good as the other places, but there is tin enough in it to leave a profit on its working. As they have been working but a short time, there is not reat extent of ground laid open for an inspector to make a long report on, but I have no doubt that an immense quantity of profitable tin ground will be found above the adit when they are in circumstances to clear out more of the old men's workings. The other lodes in the sett are worthy attention after they have got things in full working order. On No. 1 lode I found a splendid new 30-ft. water-wheel erected, and a 16-head stamps, axle attached. They have stamped from 15 to 20 tons of the lode, and it looks very well in the strips. They are busy preparing places for the round buddles, some of which will be ready to work in about a week; they will then commence stamping regularly. I see that they must erect a calcining-oven before they can dress tin for the market. I think it will take about 200*l*. more to erect calcining-ovens and lay down the dressing-floors as they should be. This will take three months to complete; when they have completed their dressing-floors, and put a full staff to work on their tin ground, I see nothing to prevent them making good profits. The mine can be worked cheap, not having to pump water; and as it is so near the surface the expense of drawing the tin will be easy. I think the shareholders have reason to congratulate themselves upon opening the ground with such a moderate outlay.—JAMES ROWE.

*Roche, St. Austell, April* 3.—There are several known lodes in the sett, and the mine is in a rich tin district, having Trumpet Consols and all the Lovell mines in its immediate neighbourhood. I find some of the lodes in this sett have been worked very extensively on the backs by the ancient miners. On one of these lodes, called the Great Lode, I find that a cross-cut adit has been driven home, and intersecting the lode towards the eastern boundary of the sett 200 fms. in length, and at the intersection of this adit with the lode a shaft has been sunk 17 fms. from the surface. The lode here is 4 ft. wide, going east, and is worth fully 20*l*. per fathom, a most promising lode indeed. The lode west of cross-cut is a little disordered at the bottom of the adit, and it appears to me that the adit is being driven by the side of the lode, carrying a part of it, consequently I could not see all the lode. Going west from this point the hill rises fast, and a shallow adit has been driven west some considerable distance; I think this adit is about 6 fms. above the bottom adit. Here, 5 fms. west of the shaft, the lode is very wide, 8 or 9 ft., a most promising lode, and will yield good paying work for tin, and pay well for taking away, as it can be raised so cheaply. Still further west an old shaft is being cleared up which was sunk on this lode, and some rich stones of tin have been found in the old attle, thus indicating that the old miners had rich work for tin. I am inclined to think that this is the main lode in the mine. I am very pleased with its appearance at the bottom, 17 fms. from the surface; a more promising lode cannot be seen, and it is worthy of remark that the lode has considerably improved in value in 4 fms. sinking. Capt. Rowe and myself broke out of the lode several samples, and found them nearly all very rich for tin, and you have now large quantities available for the stamps. I would suggest to beat away the lode underhand west, as by this mode of working you would raise almost any amount of tinstuff for the stamps, and at a cheap rate, and prove the value of the lode as well. The same remark will apply to the east stope. The stratum in this mine, like most all the other mines in this district, is granite, and is the tin-bearing ground of the district. I would recommend the laying down a tramway from the shaft to the stamps at once, that the tinstuff be trammed direct from the shaft into the stamps. When this is done you will be in a position at once to pay cost and leave a good profit, in my opinion. In the eastern part of the sett, in the valley, you have a splendid new water-wheel, and 16 heads of stamps attached, all new, and in excellent working order; a part of the dressing-floors is laid out, with 12 drags or tyres laid down. I beg to remark here, that in excavating the ground for the tin dressing-floors it must have cost a great deal of labour, more than, perhaps, it was first calculated upon, as in taking out the ground a bed of granite was found, which rendered it slow and costly, but now this work being nearly done the cost will not be incurred again. Also, in bringing home the level to carry away the water from the stamps, wheel, &c., hard granite was found, and this rendered the progress costly and slow. The same was found in bringing home the water over the wheel. Looking at all the difficulties I consider a good deal of work has been done, and looking at the mine generally, with its facilities for working, having water power for stamping, and such large quantities of rich tin ground now available for the stamps, I cannot but think that you have a valuable mine. I must say that I am highly pleased with the lode. Going east, in the deep adit, I do not remember seeing a more promising lode at that depth, and I think it will be found very rich in depth. I would recommend the driving of the ends, both east and west, at once, at the deep adit, as by this you would lay open immense quantities of rich tin ground, that can be taken away at a good profit.—THOMAS PARKYN.

The CHAIRMAN said he felt sure that the meeting would agree with him in saying that the reports just read were unexpectedly and eminently satisfactory. (Hear, hear.) When they called to mind the very short time the company had been working the mine, and the comparatively small sum that they had expended upon it, they must be highly gratified to find that they had not only as good prospects before them as they hoped to have; but, beyond, and more cheering still, that they had opened upon a lode so valuable, and at so shallow a depth. (Hear.) The stamps that had been erected, and were so satisfactory in working, would soon enable them to make good returns of tin; and when the new dressing-floors and calciner were completed, as they hoped they would be in three or four months, they would no doubt find themselves in possession of a valuable property—(hear)—especially if the price of tin maintained something like its present standard, as there was good reason to think it would He (the Chairman) concluded by moving that the statement of accounts, as also the reports of the agent and the special inspectors, just read, be received, adopted, and printed for circulation amongst the shareholders.

A SHAREHOLDER said he quite agreed with the Chairman in believing that they had a good mine, acquired at a very small cost. The reports that had been read gave them reason to hope that one more call would suffice to bring the mine into a paying condition, and then, after that, they might look for good and enduring dividends. (Hear.)

Mr. BARTLETT said he was highly pleased to think that his anticipations regarding the mine were being so speedily realised, and he had no doubt the shareholders would reap a good profit upon their investments. (Hear.)

The SECRETARY said he held a letter in his hand, written yesterday by Capt. Nancarrow, which said, "You must find us money for the next three months, and then we hope to stand on our own legs, and pay you back again."

Mr. CHAPMAN expressed his concurrence in what had been said by Mr. Bartlett, and was gratified to think that those whom he had induced to purchase into the mine would so soon realise the expectations he had held out to them. He had not spoken of the probable value of the mine until after he and Mr. Bartlett had received the best advice, and made several personal inspections, and they had not been disappointed. The shares were now honestly worth more than the shares in many Cornish mines selling at 3*l*. or 4*l*. (Hear.)

The motion was then put and unanimously adopted.

It was then resolved that a call of 3s. be made to meet the costs of the new dressing-floors, calciner, &c., and to carry on the workings for the next three months. A vote of thanks to the Chairman closed the proceedings.

[For remainder of Meetings see to-day's Journal.]

## THE SOUTH AUSTRALIAN GOLD FIELDS.

The report of Mr. W. J. PETERSWALD, the gold fields Warden, to which reference was made in last week's Journal, contains much interesting information concerning the progress and prospects of gold mining in South Australia, especially when it is considered that he has been dependent upon the voluntary aid of those concerned, and that these are decidedly averse to supply particulars. The first decided rush was that which took place in July, 1852, to Chapman's gulley, near Echunga. A large number of persons were employed there for a considerable period, and about 20 or 30 settled down permanently. Gold has been got there in small quantities ever since the first rush died away; and considering the size of the gully (40 or 50 acres), it will bear comparison with some of the best Victorian fields. In three years after its discovery about 250,000*l*. worth of gold had been obtained from this locality from sinkings from 7 ft. to 35 to 40 ft. deep; machinery was then erected, and companies established, but their operations were not attended with success. Gold was also discovered at Hahndorf diggings, but nothing of great importance took place until 1868, when Jupiter's Creek, about four miles from Chapman's Gully, was discovered. This attracted a population of about 2000 for a month or two, but there are now not above 200 there. The gold is strongly impregnated with iron, nuggetty and water-worn, and of an inferior description to that obtained on the old digging. The largest nugget found there weighed 1 lb. A number of reef claims have been taken out, and worked without any good results; the gully is now almost abandoned to puddlers. In February, 1870, a rush took place to the Onkaparinga river, which lasted all through the dry season, and gave profitable employment to about 150 men. About 800 ozs. of gold were obtained. In connection with this good surfacing was discovered on a hill near the river, and led to the opening up of the Sterling reef. Machinery was erected by the company working this reef, and from the numerous good prospects obtained little doubt exists as to the payable nature of the results when crushing operations are commenced. Gold has also been found at the Meadows, Lobethal, and many other spots in the vicinity.

The Barossa gold field was discovered in September, 1868, and the rush to it exceeded any yet known in the colony, about 4000 persons being on the ground during the first month. Operations were commenced at Spike Gully. There have been several hills opened up near Spike Gully, and another lately near Williamstown, four miles off, which promises to rival anything yet found. Some of the crushings obtained from this cement have proved highly satisfactory, having shown 4, 5, and 6 oz. per ton. Victoria Hill especially has turned out a large quantity of gold, and would bear favourable comparison with the cement hills in the other colonies. There are two quartz-crushing machines on the ground, which are kept fairly employed. The gold obtained here is of a very superior quality, averaging 3*l*. 18s. per ounce. A valuable discovery was made at Hamlin Gully (private property), about eight miles from Barossa, in the Humbug Scrub, from which a considerable quantity of gold was obtained, and which is still being worked. The existence of gold in the Para river has also been ascertained, although no work has as yet been done: he estimates the yield of gold from this locality since 1868 at about 95,000*l*. worth. In December, 1869, gold was found in a small gully about one mile from Mount Pleasant, which has proved very rich, having yielded to the present time about 1300 ozs. This gully is only about ¼ mile long, yet has supported an average population of about 40 persons. He regrets Crown lands in the neighbourhood are so limited, as there is little doubt that the numerous gulleys adjacent (in private property) would, if available, support a large population.

About the same time as this discovery some excitement was caused by the finding of auriferous quartz on some hills adjoining Murray Flats, about 10 miles north of Palmer. A number of claims were taken out, and some companies were formed, but nothing has resulted from their operations. In 1870 the German reef was discovered, about four miles from Blumburg, and rich specimens were got near surface. There is very little doubt that if operations be steadily prosecuted they will be crowned with success.

Prospecting has hitherto been conducted under great disadvantages, the area of country tested seems considerable, but it is much broken up by private property, and even should a fair prospect be obtained the number attracted is so small that the ground in most cases gets a very imperfect trial. Gold fields at greater distances from town get much better tested than any they have yet found, as miners would not be so ready to leave them, and the obstruction of private property would be less frequent. The results of reefing operations hitherto have not been so encouraging, and he calls attention to the ways in which reefs are worked there. He points out that the system of forming companies and giving bonuses to prospectors for discoveries is liable to very severe abuses, and tends to encourage illegitimate speculations. The prospector is under strong temptation to salt his discovery, and in the majority of cases the company is merely got up for exchange trafficking. He thinks the ordinary Victorian method much better, and more likely to secure *bona fide* results. He believes a great depth will have to be reached before the settled country is arrived at, when alone they may look for rich deposits, and unless miners and capitalists agree to work after some such system he has little hopes of good results. The quantity of gold already obtained, found as it has been in patches, must have been fed from some source, and he anticipates that deep sinking will lead to the most valuable results, and open up an entirely new era in the history of South Australian mining enterprise.

## FOREIGN MINING AND METALLURGY.

The state of affairs remains much the same in the Belgian iron trade. A satisfactory current of orders prevails for all descriptions of iron; but work is, nevertheless, not so abundant as could be desired, and difficulty is still experienced in obtaining large contracts. The advices received from other countries are, however, in some respects favourable to Belgium. In France everything languishes. In Germany a revival has not yet taken place in affairs; labour makes default, and some months must elapse before the situation regains its ordinary character. Belgium will naturally profit to some extent from these circumstances. The Morlanwelz Railway Plant Construction Company has been paying this month a dividend of 1*l*. 8s. per share. The dividend of the Monceau-sur-Sambre Blast Furnaces Company for 1870 has been fixed at 1*l*. per share; this dividend is not, however, at present payable. The French concern known as the Naval and Railway Blast Furnaces, Forges, and Steel Works Company announces that, in consequence of the insufficient amount of profit realised, no dividend can be paid upon the share capital for the year 1869-70.

The state of the Belgian coal trade is represented to be becoming rather worse than otherwise. In consequence of the civil war in France the demand for Belgian coal in that country languishes; already in several collieries stocks are becoming unduly large, and the extraction has been reduced, five and even four days' work per week being the rule. Even this reduced extraction is only maintained in some cases to give employment to the working class. At present the coalowners have succeeded in maintaining prices; they had hoped that the crisis would not have been of long duration, but it has been prolonged beyond all expectations, and it is feared that the position at present held in Belgium in regard to quotations will not be much longer tenable. It is reported that some collieries have already agreed to a reduction of 5d. per ton, but this reduction would not be sufficient to attract orders, the principal industrial establishments being fully supplied. Orders do not come to hand except for coal for coking purposes, which is disposed of readily enough. To sum up, the situation is now much worse than it was two months since; then a revival in business and remunerative prices were anticipated, but now the stocks which have accumulated are so considerable that even if a revival should occur in business prices would not for some time experience any material improvement. The Graissessac (France) United Mines Company has been paying a dividend of 12s. per share. The Loire Mines Company has been paying a dividend of 3s. 4d. per share on account for 1870.

The report of the directors of the Bank of Belgium states that the Herve-Wergifosse Collieries Company continues to yield satisfactory results; the profits realised by it in 1870 exceeded those of the previous year, but the dividend will probably remain the same, and will be 1*l*. 16s. per share. The company has commenced the establishment of a new working centre, and it is endeavouring to collect resources so as to diminish, as far as possible, the amount which it will have to raise on loan. A railway on the Herve plateaux is being constructed, but the route which it takes is less favourable to the collieries than had been hoped and expected; accordingly a junction line, 1¼ to 2 miles in length, will probably be required to connect the working centre now in course of development with the nearest station. The company is negociating an arrangement for working this link line, like the main line, by means of a rent upon every ton of coal forwarded. The Esperance Collieries Blast-Furnaces and Rolling Mills Company felt during the last few months of 1869-70 not only the general influence of the circumstances of the Franco-German war, but also their direct consequences. Communications with the east of France were interrupted on the outbreak of hostilities, and the execution of important contracts for coal required for metallurgical establishments in the Moselle was interrupted. The past exercise opened well for the company, but the last few months of the year blighted the hopes which had been conceived.

A transaction in Chilian copper in bars is reported at Havre at 67*l*. per ton, while Peruvian minerals (pure standard) have made 70*l*. to 70*l*. 10s.; United States (Baltimore), 76*l*. to 78*l*.; ditto, Lake Superior, 80*l*. to 86*l*.; ditto, Mexican and Plata, in bars, 66*l*. to 68*l*.; old yellow copper, 40*l*. to 44*l*.; red ditto, 62*l*. to 66*l*. per ton. At Marseilles, Toka for consumption has made 72*l*.; Spanish, 70*l*.; and refined Chilian and Peruvian, 72*l*., with a discount of 2 per cent. At Amsterdam, Russian has made 70 fls. to 70½ fls.; Drontheim, 42 fls.; and English, 41½ fls. to 42 fls. Tin has generally sustained itself firmly. The orders remaining unexecuted from the public sale of the 30th ultimo carried the prices of Banca to 76½ fls. and 76¾ fls.; at the last dates, however, these prices were scarcely sustained, and quotations had fallen to 76 fls. There have been a few arrivals of Billiton, but they have been all quickly absorbed, and at the last dates the article commanded high rates. Zinc and lead have maintained previous rates; zinc has, if anything, shown an upward tendency. At Marseilles rolled zinc has made 28*l*. per ton, with a discount of 3 per cent. At Amsterdam, Silesian zinc has been quoted at 13 fls. to 13¼ fls. Stolberg lead has brought 11 fls. at Rotterdam, and German of various marks 10¾ fls. At Marseilles, lead in saumons, first fusion for consumption, has made 18*l*.; ditto, second fusion, 17*l*. 12s.; ditto, argentiferous, 17*l*. 12s. per ton; lead in shot, 21*l*. 4s. per ton; rolled and in pipes, 21*l*. per ton.

The great Russian ironworks at Perm, on the Kama, have just turned out thirty-eight highly-finished steel guns, of 9 inch and 11 inch bore. Similar pieces are being cast in great numbers at Petrozavodsk and other Government factories.

Valparaiso papers report the discovery of a rich deposit of copper and gold at a place situated at about 12 leagues to the east of Cordoba. The ley of the ore is said to be 48 ozs. of gold and 1450 lbs. of copper to the cajon of 6400 lbs.

COAL IN INDIA.—The "Administrative Report for Hyderabad," recently issued, contains information respecting the coal fields of Berar. The total area of the fields is stated at more than a thousand square miles, and the

coal is found at an easy working depth. The area of one field, called the Damuda, is stated to be 149 miles, and the average thickness of the coal seams at 40 ft. Dr. Oldham has estimated the amount of coal at 484,000,000 tons, and it is computed by the estimate is given in the Report of 4,840,000,000 tons, and it is computed by the Resident that this coal would last India for 800 years. We know not upon what authority this larger estimate has been made.—*Athenæum.*

## HOW TO MAKE THE LANDER HILL MINES PAY.

As the operations of the Pacific Company have directed much attention to this hill, we append the report of Mr. M. J. Ryan on the Union Pacific Tunnel, a work projected by a New York incorporation to drain and work the mines of Lander Hill:—

This tunnel has been surveyed to run from the lowest point attainable under Lander Hill to Mount Prometheus, the summit of the hill, a distance of 1 mile. The mouth of the tunnel is in the Pony Canon, on the site of the village of Clifton. The tunnel is 9 ft. by 7 ft. in size, and has been projected into the hill a distance of over 300 ft. The tunnel is well timbered, and is as creditable a piece of work of its kind as there is in the State of Nevada. The cost of running it is about $20 a foot. The Pony ledge, the pioneer ledge of the district, will probably be the first ledge cut by the tunnel, and an additional ledge, blind or otherwise, will probably be cut, on an average, every 50 ft. thereafter. At the end of Lander Hill, nearest the mouth of the tunnel, the ledges are not of as high a grade of ore as those of the ruby region of the hill. They contain more base metals, at least near the surface, than the ruby section, and for that reason they have not been developed at all, as until very recently the mills at Austin were incapable of treating effectually what are generally known as rebellious ores. By some of the furnaces now in use those ores can be advantageously treated at comparatively little expense. A fair return may, therefore, be expected from these ledges; as they are cut, they can be drifted on to the right and left of the tunnel, the extraction of ores and the projection of the tunnel being continued simultaneously. If the tunnel be continued to the ultimate point proposed it must intersect nearly every vein on Lander Hill. These veins will be cut at depths varying from 300 ft. to 1500 ft. and upwards. The mines of this hill are in micaceous granite, both the walls and country rock being of this formation. They are very narrow at the surface—from 6 in. to 18 in. on top, but widen somewhat on going down on them several hundred feet. As the walls are firm but little timber is required. A few geological facts may be stated here for the convenience of the unprofessional reader. In the earth's crust distinct mineral masses occupy definite spaces, and exhibit a certain order of arrangement, as limestone, chalk, granite, clay, &c. The chronological order of these masses is determined by their relative positions, and by the fossils embedded in them. Granite is the oldest formation, and underlies all others. From shrinkage, or some other cause not exactly understood, this crust of granite at some time opened in nearly parallel lines from north-west to south-east. Through these crevices, or fissures, metallic veins were pushed up from below by some internal force. These metallic veins are what constitute the mineral wealth of Lander Hill. The casings of many of these small veins are often found highly polished by attrition, and their richness is remarkable. These veins owe their origin to the chronological period that gave birth to the best silver mines in the world. The silver in these veins is found combined with sulphur and antimony below the water-line, while above it usually exists in the form of a chloride. It is probable that the silver originally existed as a sulphuret, and that that portion of the veins now exposed to the atmosphere became decomposed by that element changing the sulphurets into sulphuric acid, and leaving the silver free. The acid reacting upon the silver formed sulphate of silver, which is insoluble in water. The water from the surface filtering through these veins slowly has washed the silver away, and left the veins nearly barren. Hence many veins that are rich below water are nearly barren at the surface. The portion of the vein that is covered by water is protected from the action of oxygen. As these chemical changes are constantly in operation, it is seldom that a vein is found to be entirely barren at the surface. Still a large number of veins, which are very rich below the water-line, show only slight traces of silver at the surface. These changes, which in Nature's laboratory require hundreds of years, are effected in a few hours by an improved furnace.

The ledges of Lander Hill are nearly all of one uniform dip and strike. The line of strike being from north-west to south-east, they dip north-east usually at the surface at an angle of about 35°. Their normal dip is about 70°. Faults and slides occur in nearly all the veins, especially in those situated near the ravines. These slides are often 50 ft. and upwards in one place, while in some this distance is made up by several lesser slides. This distance is assumed, as the first ledge found in the line of strike is taken for the one lost, whereas it may be another vein. In a locality where veins are so very numerous identification is nearly out of the question. The difficulties of mining from the surface on this hill are so very great, on account of the narrowness of the veins, the breaks in them, and the great expense attendant on mining them, that but very few companies are now actively engaged in working their ledges, although the hill is universally conceded by mineralogists to be remarkably rich. The tunnel running hundreds of feet lower under these veins than they have yet been worked, will remedy the error of attempting to work, profitably, such small faulty veins from the surface. The tunnel as it progresses will thoroughly drain the mines it cuts, thus proving itself a great economiser, as one of the heaviest expenses mining companies have to meet, on striking water in their shafts, is for the erection of steam hoisting works. The water thus drained and run through the tunnel will be valuable for mill purposes, irrigation, and for the use of the mining population that will spring up on the cutting of a number of rich veins. No better point could have been chosen for a tunnel site than that selected by the company. The peculiar formation of this hill renders it evident to practical men that tunnelling is the only mode that will thoroughly prospect and open for profitable working its many veins—those already prospected or opened, as well as the blind veins that will be cut in the progress of the work. All these ledges become the property of the company on being cut, as they can be located by it as soon as they are tapped. Should parties working on the surface claim any of these ledges as their property the onus of proof would devolve on them. Should full proof be made these parties would undoubtedly be glad to avail themselves of the tunnel through which to work their ledges—witness the action of the companies on the Comstock lode, who have agreed to pay to pay the Sutro Tunnel Company a royalty of $2 a ton on the ore taken through that tunnel. To sum up, this tunnel, if projected to the point contemplated, is sure to cut a number of very rich ledges at a depth, and consequently must be of great value in developing the mines of the hill.

From the report of Messrs. Adelberg and Raymond, on the Savannah ledge, we take the following extract:—

"Not a single claim on Lander Hill, located in a district vein, has ever failed to produce abundant and valuable ore. The only difficulties encountered have arisen from the ignorance of miners, or the lack of capital and adequate machinery to open the lodes for permanent work. . . . . The reputation of the ledge has always been good. It is considered, and is, an excellent representative of those comparatively narrow veins standing in granite, and distinguished by unmistakable marks of great geological antiquity, which we have always held to be the most reliable base for mining operations. . . . . The settled character of these lodes can be observed only below water level, since above that line they have been altered by surface agencies, which have oxydised their base metals and converted their silver ores into chlorides, bromides, and iodides."

In his first report as mining commissioner, Mr. Raymond refers to the tunnelling of Lander Hill as a feasible subject, and one well worthy of the attention of capitalists.

## FOREIGN MINES.

CHONTALES (Gold and Silver).—Mr. Belt, March 6: Return of gold for the month of February, 423 ozs., from 1010 tons of stuff; average yield, 8⅛ dwts. per ton.—Cost for the month, $4748, leaving a profit of $1145. The San Antonio Mine continues to open out satisfactorily, and the Connection level has given some higher produce ore. The operations of San Domingo and San Benito Mines are being extended (as far as his limited means will allow), with every prospect of getting into good ore ground. (Altogether, Mr. Belt speaks highly of the future prospects of the mines.) The health of the establisment continues good.

— J. Tonkin, W. Evans, March 4: San Antonio: No. 1 stope, in the back of No. 6 level, has been stoped 104¾ varas; lode 3 ft. wide, worth 5 dwts. of gold per ton. No. 2 stope, in the back of the same level, has been stoped 52¾ varas; lode 2½ ft. wide, worth 7 dwts. of gold per ton. The stope in the back of No. 5 level, west of Piper's shaft, has been stoped 57¾ varas; lode 2½ ft. wide, worth 1 oz. of gold per ton. A stope in the back of Connection level has been stoped 8 varas; lode 3½ ft. wide, worth 15 dwts. of gold per ton. No. 6 level has been driven 10½ varas, on a lode 5 ft. wide, worth 3 dwts. of gold per ton. The Connection level has been driven east on the course of the lode 28 varas, which is 3 ft. wide, worth 15 dwts. of gold for the first 15 varas, after which it became poor and disordered. The San Antonio deep cross-cut has been extended 9 varas; the ground is hard and difficult for driving.—Santo Domingo: The rise in the back of Santo Domingo deep level has been put up 14 varas, on a lode yielding 3 dwts. of gold per ton. We have also cleared and secured 73 varas in the No. 3 level, at Santo Domingo, and commenced a rise in the back of the same; the lode is from 2 to 3 ft. wide, producing 5 dwts. of gold per ton.—West San Benito: The West San Benito level has been driven 11 varas, on a lode yielding 3 dwts. of gold per ton. We have also driven 9 varas in the back of this level, lode from 4 to 5 ft. wide, worth 3 dwts. of gold per ton. We are pleased to be able to report a decided improvement in several parts of the mines, and we have sent to the stamps this month 1010 tons of stuff, at an average yield of 8½ dwts. of gold per ton, equal 423 ozs. melted gold.

ALMADA AND TIRITO (Silver).—The directors have received the following letter, dated Feb. 20, from their manager, Mr. J. P. Clemes:—Tirito: On Wednesday last in the tunnel end north we cut a very large stream of water, and at the same time encountered an important improvement in the lode; it is now yielding a fair proportion of pitanque, and I should say from all the indications that it is not an isolated or small deposit. On the whole, it is the best thing I have seen in the mine. We have not yet fully cut through to the east side, but this week we shall make a good opening, and I shall be able to give more information in the next.

JAVALI.—Capt. Sohns, reports under date March 6:—During the last month we have driven in Pollock's tunnel west 7¼ varas, east 3¼ varas, in level 7, west of Socorro, 17¾ varas, east 10½ varas, and in level 6 west 15 varas. We have also driven 10 varas in a rise from level 6 up to level 3, altogether (say) 64 varas, which yielded about 500 tons of ore of good quality. The stope on the surface of Socorro has given about 600 tons of ore. We have now accumulated about 2000 tons of broken ore, which I shall bring to the mill during this dry season. In consequence of the rapid fall of water it has been impossible to work the 20 stamps. I was compelled to stop five on Feb. 6, and another five and one pan on the 13th, so that I have worked through the greater part of the month with only 10 stamps and one pan, the stamps making no more than from 30 to 40 clips per minute. The working has consequently been irregular, but we have ground in 23 days 630 tons of ore, yielding 258 ozs. of gold. The ore we ground was from the top of Socorro, and you will see that in the next grindiug season the mill must give a return of at least 400 ozs. by grinding 1000 tons of this ore. The expenditure of the month has been 478l. I see there is a difference of nearly 17l. between two assays of three bars shipped in December. You will, I trust, see the necessity of always having two assays made. I hope by next mail to have the pleasure of informing you that we have really commenced that most important work—the great reservoir. During the dry season I will do all in my power to curtail the expenditure, and I have already discharged some contractors in the mine, together with millmen and day labourers. The health of the establishment is excellent. Mr. Jansen, a naturalist living here, has traced the Javali River to the point where it falls into the Blewfields.

BATTLE MOUNTAIN.—Capt. Richards, March 17: Virgin: The 113 feet level, west of Hallow's shaft, is progressing as favourably as the nature of the ground (which is very hard) will admit—12 ft. has been driven; the east and west lode on which we are driving is of no value, and, in my opinion, partakes of the nature of a cross-course to the other lodes, and there is no knowing until it is proved what effect it will have thereon. The east and west lode in Roach's winze, and noticed some time ago to you, is, in my opinion, the one down upon which the ore made, and by which the lode is as completely cut off as if it had never existed; this, however, is often the case, and by driving along the said east and west lode or cross-course is the only way to find the lode again, which may be shifted a considerable distance, as per rough diagram, or not; we can only prove this by exploring the ground, and this should be done immediately, as the laying open of this cross-course yesterday, showing the ore and lode cut off, has depreciated the value of the mine (until the ore shall be found again), in my opinion, considerably, and unless funds be sent to do the necessary dead work in this and other matters, with a view of making new discoveries, the mine will soon have to be abandoned, so far as raising ore is concerned. In the bottom of the 73, at Roach's winze, which, however, is now nearer the 113, and will in future reports be noticed as such, the lode is comparatively poor, owing to disturbance of the said cross-course. In the 73 north the lode is large, about 4 ft. wide, with a very small quantity of ore; this drivage should be forced on with all speed, with a view of making discovery of a new shoot of ore. Jack's stope, in the back of the 73, is turning out a fair quantity of rich ore.—Lake Superior: Moore's rise is going up so fast as the nature of the ground and ventilation will admit; the lode is only now producing occasional stones of ore, not enough to value; as soon as the rise is communicated with the surface the sinking of the Pryce's shaft will be resumed. Ore shipped, 2588 sacks; ditto unshipped, 1674 sacks.

EXCHEQUER (Gold and Silver).—Bulliona, March 4: I am still sinking the winze, and intend going down to the 140 before I drift. Unless I get ore enough in the upper tunnel by the time I get to the 140, I propose taking the shift from there to run north from the 140, and will put the shift at present sinking to run south; and it will be hard if, between the two, I do not get ore enough to keep the mill running for some time at least.

LUSITANIAN.—April 4: At Taylor's engine-shaft, below the 140, the lode is worth 2 tons per fathom. At the 140, east of Taylor's, on Basto's lode, the lode is worth 1 ton per fathom. At the 140 west the lode is 3 ft. wide, composed of quartz. At the 130 east the lode is 7 ft. wide, composed of loose quartz. At the 130 west the lode is 1½ ft. wide, composed of quartz. At the 120 east the lode is 8 ft. wide, composed of quartz. At the 110, east of River shaft, the lode is worth 1 ton per fm. At the 90 east the lode is worth 1¾ ton per fathom. At the 70 east the lode is worth ½ ton per fathom. At the 38, east of Taylor's, the lode is worth 1 ton of ore per fathom. At the 38, west of Basto lode, the lode is very small. Winzes Nos. 83, 85, and 86, on Basto's lode, yield stones of ore. At No. 87 the lode is 4 ft. wide, worth 2 tons per fathom.—Carvalhal: At the 60, on great lode, the lode is 8 in. wide, composed of quartz. At the 50, east of incline shaft, the lode is 1½ ft. wide, worth 1 ton of blende. At the 50 west the lode is 2 ft. wide, composed of quartz and stones of lead and blende. At the 40 east the lode is 1 ft. wide, composed of quartz and country. At the 30 east the lode is 2½ ft. wide, composed of quartz. At the 20 east the lode is 1 ft. wide, composed of quartz and mundic. At the adit, west of incline shaft, on caunter lode, the lode is 4 ft. wide, composed of quartz and lead, worth 1½ ton per fathom. At the 10 west the lode is worth 1½ ton per fathom for blende. At the 20 west the lode is 2 ft. wide, composed of quartz. At the deep adit, on north lode, the lode is 2 ft. wide, composed of quartz, with mundic and spots of lead.

CAPE (Copper).—The reports of the Spectakel, Koperberg, and Springbok Mines show no material alteration from the last. The acting superintendent writes that the yearly reports from the various departments have been received, and he anticipates sending the closing papers and accounts by the following mail.—Tramway: The engine was doing "its work regularly and satisfactorily." The traffic on the tramway was eight tons out and sixteen tons in daily; and Mr. Hall writes—"Our ore traffic is increasing daily, and by end of month I expect there will be about 45 waggons between the mine and railway station, sufficient to carry 600 tons per month." The transport during February will include 100 tons of regulus, which will form part of Tacna's cargo (expected to sail for Swansea middle of March). Bills of lading are forwarded for 820 tons (together) per Patagonia and Ocean King.

[For remainder of Foreign Mines see to-day's Journal.]

## WILLOUGHBY BROTHERS' STEAM STAMPER.

A great step towards the achievement of the long-talked-of revolution in the whole economy of Cornish mining is made in the new patent Direct-Acting Steam Stamper, which has just been manufactured by WILLOUGHBY BROTHERS, of the Central Foundry, Engine Works, and Hammer Mills, Plymouth, and of the Foundry and Engine Works, Redruth. The objects of the peaceful revolutionists in this matter aim at an improvement upon the present primitive "stamps," that shall effect such a reduction of cost in crushing the ore for the dressing floors as to make the present profitable mines still more profitable, and many of the abandoned mines to pay for working. Several attempts have been made to compass the end in view with more or less success, and now Willoughby Brother enter the field under the most favourable auspices. Having had the advantage of the experience of the failures of others, they have had the intelligence of profiting thereby; they appear not only to have seen the causes of the short-comings, but to have been able to remedy them. Last week the inventors and makers invited gentlemen interested in the question to attend at the Central Foundry, Plymouth, where the machine has been erected. Several attended to see the steam stamper put to the test, and so far as the trial was carried, it answered the expectations of Willoughby Bros., and was admired by all present. The locality, of course, would not admit of the trial being as perfect as one on a mine would have been, but the intention of the makers was to give the public the quickest possible opportunity of examining the principle on which it is constructed, and of witnessing the actual crushing power.

The machine differs very considerably from those which have hitherto been offered to the public. The object of the makers has been to construct a direct-acting steam-hammer, free from the objections to those with single cylinders, so wasteful in their consumption of steam, especially in the case of Ore Stampers, where the cylinders must be made of additional length, to allow for the wearing of head and anvil. To effect this the Willoughby Brothers have constructed two cylinders in one casting, one above the other. In these cylinders plays a piston rod, to the lower end of which the stamp-head is attached. On this rod there are two pistons, one in the upper cylinder, one in the lower, and the one in the lower has an area double that in the upper cylinder. The upper cylinder is always in communication with the boiler, and is used for lifting the rod, the lower cylinder being required to give the blow. The steam entering the upper cylinder beneath the piston rod, raises it to a certain height, when a valve opens into the lower cylinder above the piston, and this gives the blow—the blow being due to the difference in the area of the two pistons, combined with the weight of rod and stamp-head—the steam, which had previously been admitted into the lifting or upper cylinder, passes back again into the boiler, so that only so much steam passes out of the lower cylinder as is actually expended in giving the blow, whatever the length of the blow be, the measure of the steam admitted being regulated by the length of the blow given. This is one of the most commendable features in the machine, and indisputably establishes its claim for economy at once. No steam-hammer in existence has ever accomplished the same result—wasting only so much steam as is required by the blow, even if it be but an inch.

Other advantages are claimed for the stamper, on account of its freedom from levers, tappits, weights, or springs, and of trigging-up of head, by which the stoppage of the machine can be caused. Its simplicity of construction is very remarkable, and the moving parts are so few as to render it easy of management by any ordinary mine workman. It is also said that the wear and tear, in proportion to the work done, is far less than the ordinary stampers in use; that the cost is light compared with them; and that as in fixing, concrete masonary is needed only about the foundation, with a light shed over the machine, the whole is easily removable. In situations where a head of water can be obtained, the Ejector Condensor can be applied, making the machine fully one-third more effective without additional cost in working, and much more effective than any ordinary steam-hammer of equal lifting power could be made, the advantage being obtained by the unequal pistons in the stamper. Particulars as to prices we extract from the inventor's circular:—The following prices include boilers of superior construction with chimney and all fittings to render the stamper complete, requiring but a light shed to be constructed and concrete foundation for the anvil-block. Stampers and boilers, with fittings complete, to equal 12 ordinary heads, 180l.; ditto, 15 ordinary heads, 220l.; 24 ordinary heads, 300l.; or stamper only equal to 12 ordinary heads, 75l.; ditto, 15 ordinary heads, 95l.; ditto, 14 ordinary heads, 125l. If with patent Archimedean self-acting feeder 20l. extra.

In the machine worked the weight of the head was 2¼ cwts., and with a piston and rod 6¼ cwts. The diameter of the hammer was 12 in., and the force of the blow was estimated at a ton and a half, and the hammer will give a blow from 1 in. up to 20 in. stroke. An engine of six-horse power was employed, and the stamper worked with the greatest ease, and continuously. Nothing could well exceed the ease and regularity with which the whole of the machine worked, especially when compared with its wonderful crushing properties. No ore was at hand to test the stamper, but suitable equivalents were found. A lot of broken limestone, such as is used in metalling the streets of Plymouth, was put on the anvil, and this stood no chance, but was with a stroke or two crushed into powder. A granite block used in pitch paving—10 in. by 6 by 4—was next placed on the anvil, and shared the same fate, with no greater show of resistance. Last of all a piece of granite curbing, some 13 in. through, and harder than the majority of Cornish ore, was experimented on, and it was soon broken into fragments, and crushed into the finest powder. How far the stamper answers the desired requisite of stamping the stuff of a uniform size remains to be proved, when placed at work on a mine, but there is no doubt that it will acquit itself as efficiently in this particular as it does in others. Upon the machine being timed, it was found to be making 160 strokes a minute with the greatest regularity.

A similar machine to that tried is to be erected at Wheal Uny, at the risk of the inventors, the mine to buy it if it answers.

Another valuable thing seen at work at the foundry, was Barrett's ingenious, simple, and effectual self-acting Steam Damper Regulator and Fire Controller, by which economy in fuel, regular pressure of steam, and safety of boilers, is secured. It is an arrangement by which the steam, acting upon the damper, controls it so as to make it regulate the fire with almost as much precision as the governor regulates the speed of the engine. When once set to the pressure required, it prevents the steam from increasing beyond that pressure, by closing the damper. The fire is also checked, a very considerable economy of fuel, amounting to at least 15 per cent. secured, and the safety of the boiler made much less dependent on those in charge of it than has hitherto been possible.—*Western Daily Mercury.*

COMPRESSING AIR.—Mr. T. BROWN, Newgate-street, arranges the pumps and a steam engine for working them upon one frame. The pumps are self-acting, and the pumps and engines are placed vertically on the frame, and their pistons are connected to one crank shaft, supported to rotate in suitable bearings below the pump on the bed or foundation plate of the machine. These pumps admit the air at the downward stroke of the piston, and compress it in their upward stroke. It is preferred to use two pumps with a common top, chest, or receiver, into which the air is discharged by both pumps, its return being prevented by valves which are forced open by the pressure at the upward stroke of the piston and close at the termination of the up stroke. The top, chest, or receiver, by means of a pipe or piston may communicate with an air receiver or reservior of any suitable construction. By having the pumps arranged vertically the closing of the said valves at each stroke is effected by their own gravity without the aid of springs. On the top flange of the pump cylinders, is a plate wherein are formed circular openings which are covered by the aforesaid eduction valves. These valves are of the poppet form, and their spindles or stems are guided in sleeves formed on the covers of the air chest. This chest, which extends across both pump cylinders, not only serves as a recipient of the compressed air, but also braces and strengthens the top of the machine.

COMPRESSING AIR.—In order to compress air to be used as a blast or for other purposes Mr. N. D. SPARTALI, Liverpool, employs an air-pump fitted with a piston, which is provided with valves, to close on the advance of the piston and open at the return stroke, to admit a fresh supply of air to the front of the piston; or the piston may be solid, inlets valves being provided in the air-compressing portion of the pump. If the valvular piston is used the cover of the cylinder is fitted with valves, which open inwards to admit air to the back of the piston. The cylinder is fitted with a discharge pipe, which contracts in diameter, and then enlarges and contracts again to a smaller diameter, in some cases to again increase and contract in capacity.

ARTIFICIAL FUEL.—The invention of Mr. P. M. PARSONS, Blackheath, consists in combining chalk or other suitable carbonate of lime with coal, coke, charcoal, pitch, or other suitable carbonaceous or hydrocarbonaceous substances, in certain proportions of about one by weight of carbonaceous material to from one to four of chalk, in some cases adding a little clay, for the purpose of producing a cheap fuel for household and other uses.

PRODUCING GAS FROM OIL.—Instead of allowing the gas to be generated in retorts heated in the same manner as retorts for coal gas, Messrs. T. CLAYTON and W. H. BAILEY, Manchester, cause the generators to be heated by the ignition of the oil gas mixed with atmospheric air, the mixture being obtained by any well-known description of blowing apparatus. To obtain the greatest effect from the heat the inventors employ improved heating surfaces, by fixing on the generator one or more truncated, sugar-loafed, or other shaped cones, either plain, corrugated, or formed with serpentine indentations, and surround each cone with another cone of a similar shape in the interior of the generator, there being a space between the two, and the heat from the ignited gas and air is impinged on the surface of the smaller cone. The inventors also use flat or annular corrugated metal for heating the surfaces.

## COPPER ORES.

Sampled March 22, and sold at Tabb's Hotel, Redruth, April 6.

| Mines. | Tons. | Price. | Mines. | Tons. | Price. |
|---|---|---|---|---|---|
| West Seton | 67 | £5 15 0 | East Pool | 99 | £2 14 0 |
| ditto | 66 | 2 12 6 | ditto | 51 | 2 9 6 |
| ditto | 58 | 6 12 6 | ditto | 24 | 2 19 0 |
| ditto | 56 | 2 5 0 | West Tolgus | 53 | 3 17 6 |
| ditto | 54 | 2 5 0 | ditto | 50 | 3 9 6 |
| ditto | 51 | 6 6 0 | ditto | 40 | 3 1 6 |
| Carn Brea | 61 | 3 18 0 | North Downs | 41 | 4 12 0 |
| ditto | 58 | 2 15 6 | ditto | 40 | 4 15 6 |
| ditto | 55 | 2 1 6 | ditto | 39 | 4 6 6 |
| ditto | 49 | 7 14 0 | ditto | 22 | 4 3 6 |
| ditto | 48 | 6 6 0 | Carn Camborne | 53 | 2 15 6 |
| ditto | 27 | 3 10 0 | ditto | 50 | 2 11 6 |
| ditto | 26 | 0 13 6 | ditto | 18 | 1 12 6 |
| ditto | 20 | 7 3 0 | ditto | 6 | 1 5 6 |
| Wheal Seton | 49 | 5 1 0 | North Treskerby | 59 | 4 8 0 |
| Pendarves | 71 | 5 2 6 | ditto | 35 | 4 7 6 |
| ditto | 64 | 4 6 0 | Clifford | 29 | 5 15 0 |
| ditto | 56 | 1 8 6 | ditto | 28 | 1 16 0 |
| ditto | 39 | 4 9 6 | ditto | 25 | 2 4 0 |
| ditto | 32 | 0 11 6 | Wheal Basset | 38 | 6 2 6 |
| Crenver & Abraham | 68 | 3 3 0 | ditto | 37 | 3 16 6 |
| ditto | 67 | 3 3 0 | New Pembroke | 65 | 6 12 6 |
| ditto | 57 | 2 5 0 | East Carn Brea | 15 | 2 10 0 |
| ditto | 36 | 3 12 0 | Emily Henrietta | 7 | 6 5 6 |
| South Crofty | 62 | 2 9 6 | Great South Tolgus | 5 | 2 2 0 |
| ditto | 52 | 2 4 6 | Tremellian's Ores | 2 | 16 5 0 |
| ditto | 48 | 1 19 0 | Ennor's Ores | 2 | 2 0 6 |
| ditto | 21 | 8 2 6 | | | |

TOTAL PRODUCE.

| | | | | | |
|---|---|---|---|---|---|
| West Seton | 352 | £1511 11 0 | North Treskerby | 94 | £ 412 14 6 |
| Carn Brea | 344 | 1441 18 6 | Clifford | 82 | 272 3 0 |
| Wheal Seton, &c. | 311 | 1159 5 0 | Wheal Basset | 75 | 374 5 6 |
| Crenver & Abrah. | 228 | 683 2 0 | New Pembroke | 65 | 430 12 6 |
| South Crofty | 183 | 533 7 6 | East Carn Brea | 15 | 37 10 0 |
| East Pool | 154 | 414 16 6 | Emily Henrietta | 7 | 43 18 6 |
| West Tolgus | 143 | 502 2 6 | Great So. Tolgus | 5 | 10 10 0 |
| North Downs | 142 | 640 2 6 | Tremellian's Ores | 2 | 32 10 0 |
| Carn Camborne | 127 | 312 14 6 | Ennor's Ores | 2 | 4 1 0 |

Average standard ..... £ 99 14 0 | Average produce ..... 6¼
Average price per ton ..... £3 11 0
Quantity of ore ..... 2331 tons | Quantity of fine copper .. 152 tons 14 cwts.
Amount of money ..... £ 8,817 5 0
LAST SALE.—Average standard ..... £102 18 0—Average produce ..... 6¼
Standard of corresponding sale last month, £100 6 0—Produce, 7.

COMPANIES BY WHOM THE ORES WERE PURCHASED.

| Names. | Tons. | Amount. |
|---|---|---|
| Vivian and Sons | 631¼ | £2510 16 6 |
| Grenfell and Sons | 401¼ | 2323 19 6 |
| Sims, Willyams, and Co. | 99 | 486 9 0 |
| Williams, Foster, and Co. | 405½ | 965 9 0 |
| Mason and Elkington | 456¼ | 1459 15 3 |
| Copper Miners' Company | 137¼ | 438 7 0 |
| Charles Lambert | 60 | 58 6 0 |
| Sweetland, Tuttle, and Co. | 130½ | 574 2 9 |
| Total | 2331 | £3817 5 0 |

NO SALE on Thursday last, April 13.

Copper ores for sale at the Royal Hotel, Truro, on Thursday next—Mines and Parcels.—Devon Great Consols 1616—South Caradon 549—Marke Valley 474—Phœnix 255—Glasgow Caradon 240—Gawton Copper Mine 225—East Caradon 194—Wheal Russell 174—Bedford United 120—Hingston Down 116—Craddock Moor 103—Gonamena 72—Prince of Wales 71—Belstone 11.—Total, 4220 tons.

## COPPER ORES.

Sampled March 22, and sold at Swansea, April 11.

| Mines. | Tons. | Produce. | Price. | Mines. | Tons. | Produce. | Price. |
|---|---|---|---|---|---|---|---|
| Cape Ore | 53 | 28 | £18 5 6 | Moonta Ore | 116 | 14⅞ | £9 9 0 |
| ditto | 53 | 28¼ | 18 8 6 | ditto | 116 | 14⅞ | 9 10 0 |
| ditto | 52 | 27¾ | 18 6 6 | ditto | 100 | 15 | 9 13 6 |
| ditto | 52 | 27¾ | 18 0 0 | ditto | 100 | 15 | 9 13 6 |
| ditto | 57 | 28⅞ | 18 15 6 | ditto | 38 | 15⅛ | 9 14 0 |
| ditto | 57 | 28⅞ | 18 14 0 | ditto | 30 | 14½ | 9 5 0 |
| ditto | 57 | 29⅛ | 19 0 0 | Yanganooka | 7 | 15⅛ | 9 12 0 |
| ditto | 60 | 29⅞ | 18 18 0 | Knockmahon | 113 | 16¾ | 10 16 6 |
| ditto | 22 | 27⅞ | 17 14 6 | ditto | 80 | 9½ | 6 2 0 |
| ditto | 19 | 40½ | 26 4 0 | ditto | 78 | 9¼ | 5 19 0 |
| ditto | 19 | 54 | 35 8 0 | Berehaven | 113 | 9⅛ | 6 1 0 |
| ditto | 17 | 24⅞ | 16 3 0 | ditto | 70 | 8½ | 5 6 0 |
| ditto | 10 | 54½ | 35 3 0 | ditto | 73 | 8⅜ | 5 5 6 |
| ditto | 8 | 28¾ | 18 15 0 | Brass Ashes | 60 | 3½ | 1 4 0 |
| ditto | 2 | 39¼ | 25 14 0 | ditto | 59 | 3 | 0 17 6 |
| ditto | 63 | 29 | 18 17 6 | ditto | 117 | 6 | 2 1 6 |
| ditto | 65 | 28⅞ | 18 18 0 | Telhadella | 57 | 18½ | 12 1 0 |
| ditto | 65 | 28¾ | 18 18 0 | ditto | 12 | 26¾ | 17 11 0 |
| ditto | 69 | 34⅜ | 22 5 6 | ditto | 54 | 16 | 10 9 0 |
| ditto | 68 | 34⅜ | 22 5 6 | Copper Ore | 8 | 15½ | 9 15 0 |
| ditto | 19 | 29½ | 19 1 0 | ditto | 5 | 12¼ | 7 12 6 |
| ditto | 89 | 16¾ | 10 11 0 | ditto | 1 | 22 | 14 0 0 |
| ditto | 89 | 16¾ | 10 9 0 | Copper Reg. | 6 | 35 | 21 6 0 |
| ditto | 88 | 16⅜ | 10 10 6 | | | | |

TOTAL PRODUCE.

| | | | | | |
|---|---|---|---|---|---|
| Cape Ore | 888 | £17,653 9 6 | Brass Ashes | 236 | £ 366 8 0 |
| Moonta Ore | 766 | 7,572 0 0 | Telhadella | 123 | 1,461 15 0 |
| Yanganooka | 7 | 67 4 0 | Copper Ore | 14 | 130 2 6 |
| Knockmahon | 271 | 2,175 6 6 | Copper Regulus | 6 | 127 16 0 |
| Berehaven | 256 | 1,439 14 6 | | | |

COMPANIES BY WHOM THE ORES WERE PURCHASED.

| Names. | Tons. | Amount. |
|---|---|---|
| Copper Miners' Company | 180 | £1980 5 6 |
| P. Grenfell and Sons | 336 | 3516 5 0 |
| Sims, Willyams, and Co. | 73 | 1805 9 6 |
| Vivian and Sons | 547 | 4119 1 0 |
| Williams, Foster, and Co. | 893 | 8938 1 0 |
| British and Foreign Copper Company | 142 | 3227 8 6 |
| Mason and Elkington | 92 | 1738 16 0 |
| Charles Lambert | 41 | 745 5 0 |
| Ravenhead Copper Company | 84 | 1582 3 6 |
| Sweetland, Tuttle, and Co. | 179 | 3341 1 0 |
| Total | 2567 | £30,993 16 0 |

NO SALE on May 2.

TOTALS AND AVERAGES.

| 21 cwts. | Produce. | Price. | Per unit. | Standard. |
|---|---|---|---|---|
| Whole sale.. 2567 | 18⅜ | £12 1 6 | 12s. 11d. | £ 86 7 6 |

# TANGYE BROTHERS AND HOLMAN,

## 10, LAURENCE POUNTNEY LANE, LONDON,

## CORNWALL WORKS (TANGYE BROTHERS), BIRMINGHAM.

SOLE MAKERS OF

## THE "SPECIAL" STEAM PUMPS.

**Over 1000 in Use.**

IN USE AT

The Black Boy Collieries, Bishop Auckland.

The Westminster Collieries, Wrexham.

The Monkwearmouth Colliery, Sunderland.

The South Benwell Colliery Newcastle-on-Tyne.

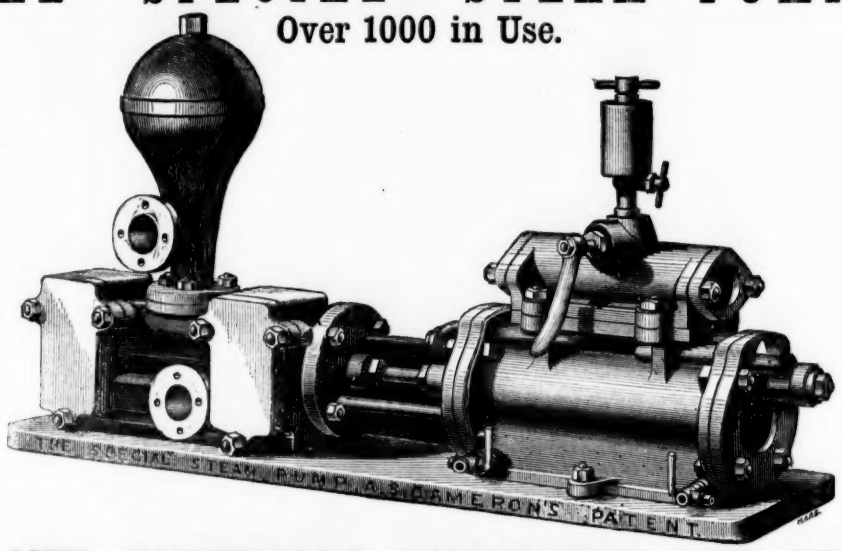
Messrs. Bagnall and Sons Colliery, South Staffordshire.

Acomb Colliery, Hexham.

North Bitchburn Colliery, Durham.

Brancepeth Colliery, Durham, &c., &c.

And numerous others.




NOTE.

Requires NO Shafting, Gearing, Riggers, or Belts.

All Double-Acting.

Works at any Speed, and any Pressure of Steam.

Will Force to any Height.

Delivers a constant stream.

Can be placed any distance away from a Boiler.

Occupies little space.

Simple, Durable, Economical.

## NO FLY-WHEEL, CRANK, GOVERNORS, CONNECTING ROD, GUIDE, OR ECCENTRIC.

Supplied to H.M.'s Arsenal and Dockyards at Woolwich, Chatham, and Devonport, also for use on board H.M.'s Ships, Hercules and Monarch.

FORTY THOUS ND GALLONS PER HOUR IS BEING RAISED 40 FEET HIGH AT MR. MCMURRAY'S PAPER MILL, WANDSWORTH, BY THE "SPECIAL" STEAM PUMP.

## THE "SPECIAL" STEAM PUMP AS APPLIED TO DRAINING QUARRIES.

The engraving illustrates the "SPECIAL" Steam Pump as employed in draining quarries. At the Bangor and Carnarvon Slate Company's Quarries, in Wales, four or five of these pumps, of different dimensions, are at work, as well as at other quarries in various parts of the kingdom.

The pump being fixed in the required position, steam can be supplied by means of a felted steam-pipe from any boiler situated several hundred feet away from the pump; and although a little extra condensation would in such case take place, this system

of draining quarries is found far more economical than employing detached engines and pumps, with their cumbrous details of shafting, gearing, riggers, and belts.

The "SPECIAL" Steam Pump can be adapted to work at either high or low pressure steam, and to discharge the water to a vertical height of from 200 to 400 feet. For very high lifts, pumps with long strokes are recommended.

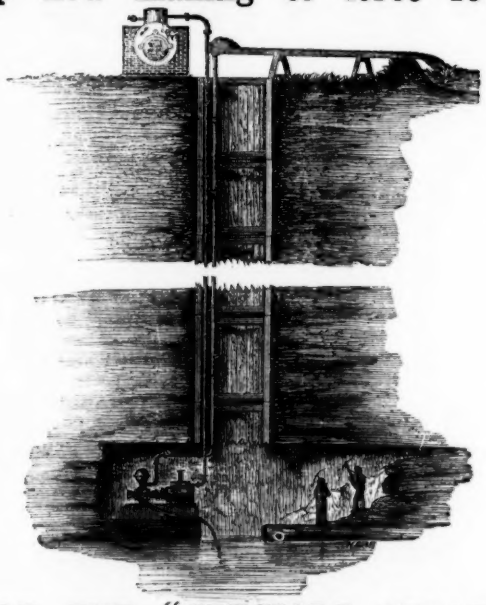
The pump is very portable, and can be readily lowered nearer to the water as the work proceeds.

## THE "SPECIAL" STEAM PUMP AS APPLIED FOR DRAINING MINES.

**One "SPECIAL" Steam Pump now making to force 1040 feet in one direct lift.**

The arrangement in the accompanying illustration shows an economical method of draining mines without the expense of erecting surface-engines, fixing pump-rods, or other gearing. A boiler adjacent to the pit's mouth is all that is necessary on the surface; from thence steam may readily be taken down, by means of a felted steam-pipe, to connect the pump with the boiler. The pump may be placed in any situation that may be convenient for working it, and connecting the steam, suction, and delivery pipes.

These engines can be fixed and set to work in a



comparatively short time, and also at a very smal outlay. They are used in large mines as auxiliary engines, and will be found invaluable adjuncts in al mining operations.

To estimate the quantity of water to be raised by any given size of pump refer to the tabulated list below. It is recommended to use long-stroke pumps where the height exceeds 100 ft., so that the largest result may be obtained with a minimum wear and tear of the pump pistons and valves. The pumps are provided with doors for ready access to all working parts.

## PRICES OF THE "SPECIAL" STEAM PUMPS.

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Steam Cylinder .....inches | 2½ | 3 | 4 | 4 | 6 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 10 | 10 | 12 | 12 | 14 | 16 | 24 |
| Diameter of Water Cylinder ..... ..inches | 1¼ | 1½ | 2 | 4 | 3 | 4 | 6 | 5 | 6 | 7 | 4 | 6 | 7 | 8 | 6 | 7 | 8 | 10 | 12 | 7 | 10 |
| Length of Stroke ..... .....inches | 6 | 9 | 9 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 18 | 24 | 24 | 24 | 24 |
| Strokes per minute ..... | 100 | 100 | 75 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 35 | — | — | — | — |
| Gallons per hour ..... | 310 | 680 | 910 | 3250 | 1830 | 3250 | 7330 | 5070 | 7330 | 9750 | 3250 | 7330 | 9500 | 13,000 | 7330 | 9500 | 13,000 | — | — | — | — |
| PRICE..... | £10 | £15 | £20 | £35 | £30 | £40 | £40 10 | £50 | £52 10 | £57 10 | £50 | £55 | £65 | £75 | £70 | £80 | £100 | — | — | — | — |

IF BRASS LINED, OR SOLID BRASS OR GUN-METAL WATER CYLINDERS, WITH COPPER AIR VESSELS, EXTRA, ACCORDING TO SIZE.

Any Combination can be made between the Steam and Water Cylinders, provided the Lengths of Stroke are the same, thus—8 in. Steam and 3 in. Water, or 10 in. Steam and 3 in. Water, adapted to height of lift and pressure of steam, and so on.

## TANGYE BROTHERS & HOLMAN: Offices & Warehouse, 10, Laurence Pountney-lane, London, E.C.

NORTHERN DISTRICT: ALFRED STANSFIELD RAKE, ST. NICHOLAS BUILDINGS, NEWCASTLE-UPON-TYNE.
DEPOT FOR SOUTH WALES: BANK CHAMBERS, NEWPORT, MON.—MESSRS. STEEL, RAKE, & CO.

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